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MODERN Machine Shop

VOLUME 17 • NUMBER 5
OCTOBER, 1944

Contents

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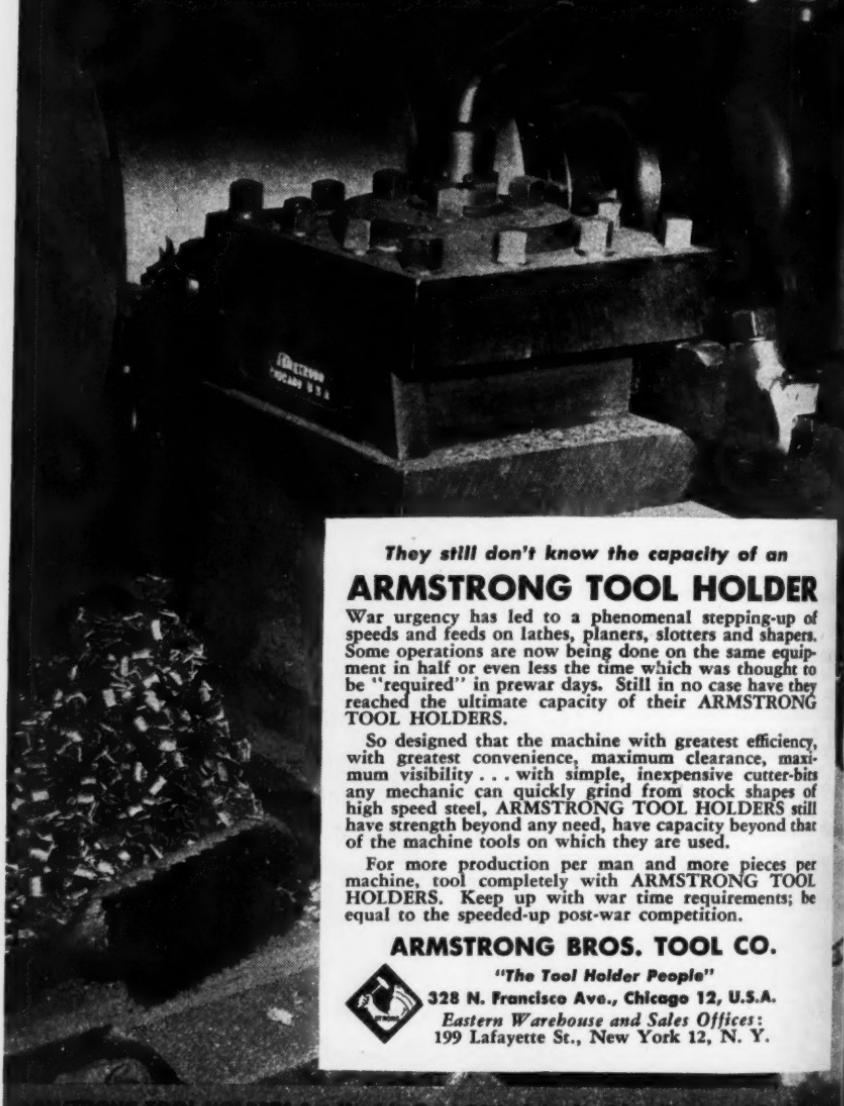
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MODERN Machine Shop

OCTOBER, 1944

VOL. 17, No. 5

CINCINNATI, OHIO

We Present---

—as the feature article in this month's issue—"Marine Engines By Hendy, II." In this, the second half of the article, the assembling and machining operations on the crankshafts are described; also treated are the machining and balancing operations on the rotor for an 8,500 h.p. steam turbine.

—on page 138—"Use of Negative Rake Tools in Production of Aircraft Parts," written by Mr. J. Q. Holmes, Master Mechanic, Eastern Aircraft Division, General Motors Corporation, Linden, New Jersey. In this article Mr. Holmes tells how, upon experimenting with negative rake tools for milling, turret lathe and precision boring work, his company was successful in getting the "most of the best for the least" in the production of "Wilder Wildcat" fighter planes for the United States Navy.

—on page 166—an announcement of the 26th Annual National Metal Congress and War Conference Displays to be held at the Public Auditorium, Cleveland, Ohio, October 16 to 20. Following pages present the Programs of the Technical Societies including the American Society for Metals, A.I.M.E. Metals Divisions, Society for Experimental Stress Analysis, American Welding Society, American Industrial Radium and X-Ray Society, Inc.; and a list of the exhibitors participating in the War Conference Displays.

—on page 310—the "New Shop Equipment" department, followed by cartoon and other features.

Fig. 12—Removing a Crankshaft Web from the Hot-Oil Tank. It is Transported to the Shrinking Stand, Where it is Assembled to the Crankpin while Hot.



Marine Engines By Hendy, II.

In this, the second half of the article, the assembling and machining operations on the crankshaft are described.

Machining and balancing operations on the rotor for an 8,500-h.p. steam turbine are included.

By HOWARD CAMPBELL

THE Liberty Ship engine—a 2,500-h. p. triple-expansion reciprocating marine steam engine—is a giant two-story power plant weighing 137 tons. Its crankshaft alone weighs 20 tons and is an assembled job, the crankpins, thrust shafts, and webs being separate and individual pieces.

Six webs, each weighing 1800 pounds, are used in the assembling of

one shaft. When ready to assemble the webs to the shaft, the webs are moved, in sets of two, into special heating tanks containing a special heat-resistant oil that has been heated to a temperature of 550 degrees F. The webs are immersed in the hot oil for a period of three hours which is sufficient to bring them to the required amount of expansion.

moving a
Web from
Tank. It
is to the
Stand.
Assen-
Crankpin
Hot.

While the webs are being heated, the journal pins, crankpins and thrust shaft are placed in position on the shrinking stand, the webs being spaced at the correct angles to each other by the use of height blocks. The shrinking stand holds the journal pins and thrust shaft in the correct alignment within limits of 0.005 inch. The tolerance before finish turning is 0.010 inch, and the holding bases of the stand are keyed to the bedplate to assure this accuracy of alignment.

The crankpins are brought to the shrinking stand in a semi-finished condition, the journal pins and thrust shaft being semi-finished to a tolerance of 0.050 inch, to be finished in the lathe after the shaft has been assembled. One of the principal secrets of successful crankshaft web assembly, according to Hendy engineers, is to have the webs in balanced relationship even though they may not be absolutely parallel.

When the webs have been heated sufficiently to bring them to the specified amount of expansion, the crew moves into action like a perfectly-

trained football team. A single web is hoisted from the heating tank, as shown in Fig. 12, and carried by the crane to the shrinking stand. As it is brought even with the end of the first journal two men, using bars, steer it onto the pin. At the same time a jack is placed under the web, as shown in Fig. 13, the jack being set at the approximate height to give the web the exact 120-degree angle required in relationship to the other webs.

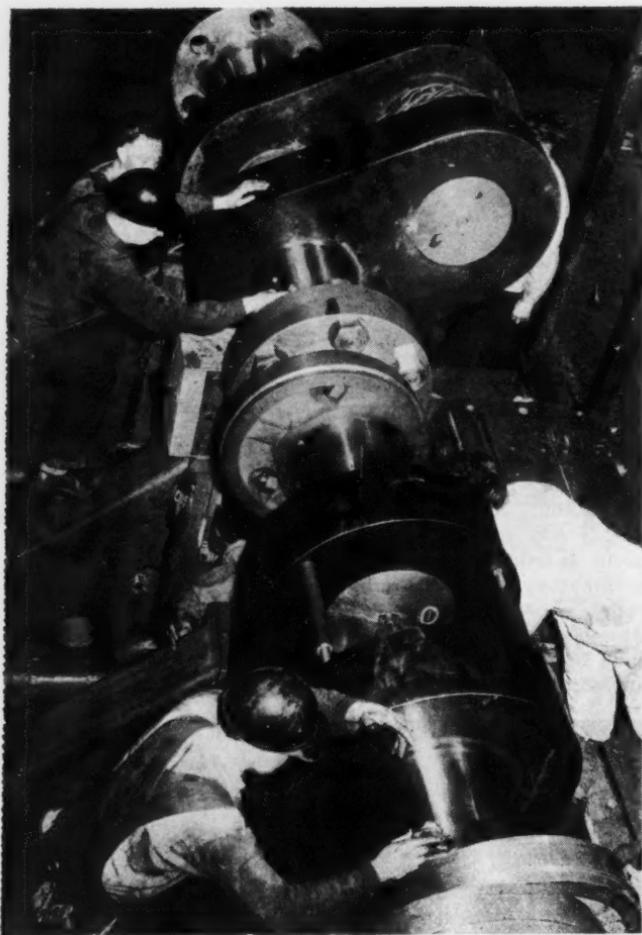
With the first web in position, a second web is brought by the crane and maneuvered into position in the same manner. The stands of the shrinking stand are moved longitudinally as required to permit the entrance of the web, and as soon as the web is in position on the crankpin, the next journal pin is moved into the opposite end of the web. Height blocks are placed under the crankpin to assure correct positioning, and the jack is removed.

The same procedure is followed with each of the two remaining sets



Fig. 13 — Assembling a Web to the Crankpin after It has Been Expanded by Heating in Hot Oil. A Jack is Set under the Web to Hold It at the Required 120 - Degree Angle to the Other Webs

Fig. 14 — Assembling a Liberty Ship Engine Crankshaft on the Shrinking Stand. The Shrinking Stand Holds the Journal Pins and Thrust Shaft in Alignment within Limits of 0.005 Inch



of webs. The time required to assemble a set of webs averages seven minutes, which is remarkably fast considering that the parts are large and heavy, that the webs must be brought by crane from the heating tanks, and that the assembling job must be done within comparatively close tolerances. The webs cool sufficiently to begin shrinking within thirty minutes after they have been anchored in place, and the completely-assembled shaft is left to cool for a

period of twelve hours.

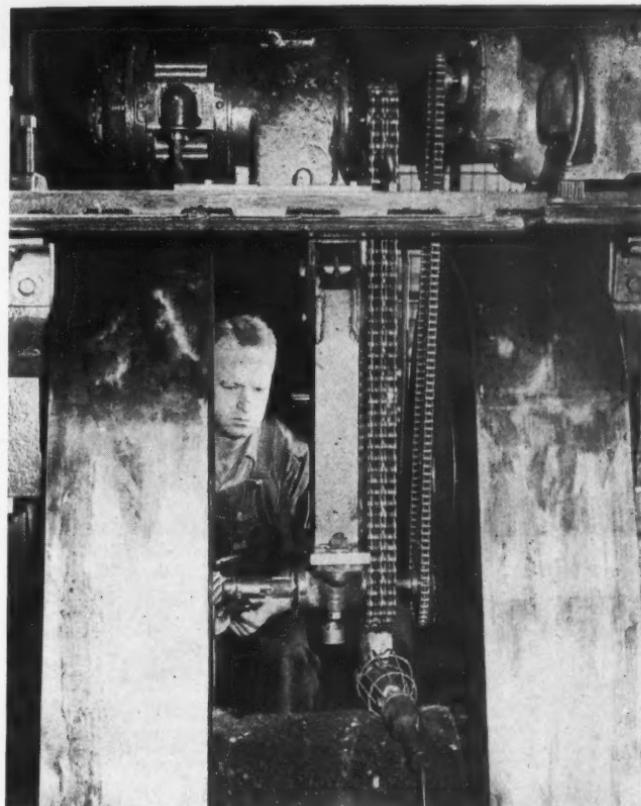
When the shaft has cooled, holes are drilled and reamed for dowels which are pressed into the holes to prevent the webs from slipping under the tremendous pressures to which they will be subjected in service.

The hole-drilling operation is performed with a portable drilling machine which can be clamped to the tops of a set of webs, as shown in Fig. 15. Power is derived from a motor that is bolted to the base plate upon which the tool is mounted, the power being transmitted through a chain drive to the machine spindle. A gear motor is provided to feed the tool through the work, the power being transmitted through a light chain to the feed screw as shown in the illustration.

There are two inside and two outside dowels in each set of webs; thus the holes are drilled in sets of two. Following the drilling, the webs are

Assembling
Ship Engine
on the
Stand. The
Stand Holds
Pins and
Fit in Align-
ment Limits of
Inch

Fig. 15—Drilling and Reaming Holes for the Dowels which Maintain Correct Alignment of the Crankshaft Webs in Service, using a Special Hendy-Built Portable Drilling Machine



tapped for Allen setscrews.

The illustration Fig. 16 shows the operation of milling the keyways for the eccentrics which are cut in the crankshafts with the aid of a portable keyway miller. An end milling cutter is used, held in a vertical spindle which can be fed by hand both vertically and horizontally so as to obtain the proper depth and length.

The tool is positioned on the shaft by means of a huge hinged clamp which locks around the shaft. Portable tools of the type shown and described here simplify the task considerably, because it is much easier to move such tools to the job than it would be to move huge work to the several machines.

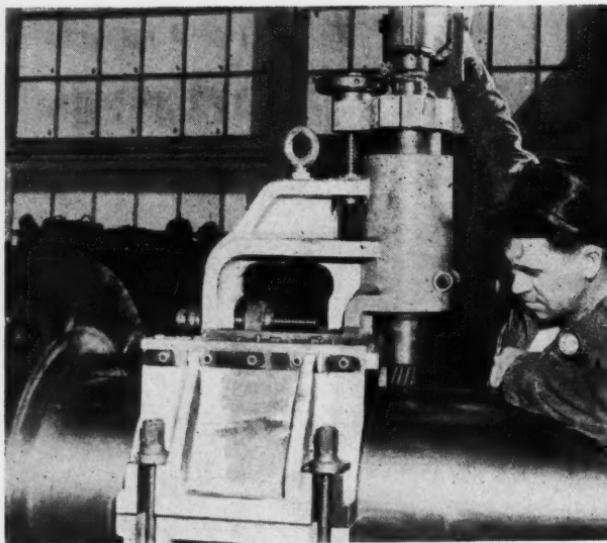
Following the cutting of the keyways, the two major parts of the shaft are brought together on a lining-up stand and a portable line reamer is used to finish the flange bolt holes to size and in correct alignment. With this fixture, tolerances

under 0.001 inch are consistently achieved, permitting interchangeability of bolts.

Flanges are machined in pairs, and the matching sections are always kept together until their final assembly on the ship. After the flanges have been bolted together, with jacks installed between the webs to hold them in perfect alignment, the entire shaft is moved to the finishing department. Here counterweights are bolted to the webs, the shaft is swung into the big lathe shown in Fig. 17, and a smooth, even finishing cut is taken.

The illustration Fig. 18 shows the

Fig. 16—Milling Keyways in the Crankshafts for Eccentrics, Using a Portable Milling Machine



operation of tapping the steam intake valve on a high pressure cylin-

radial drilling machine is ideal for this operation, also, because in addition to

Fig. 17—With Counterweights Bolted to the Webs, the Crankshaft is Swung into this Lathe and the Finishing Cut is Taken

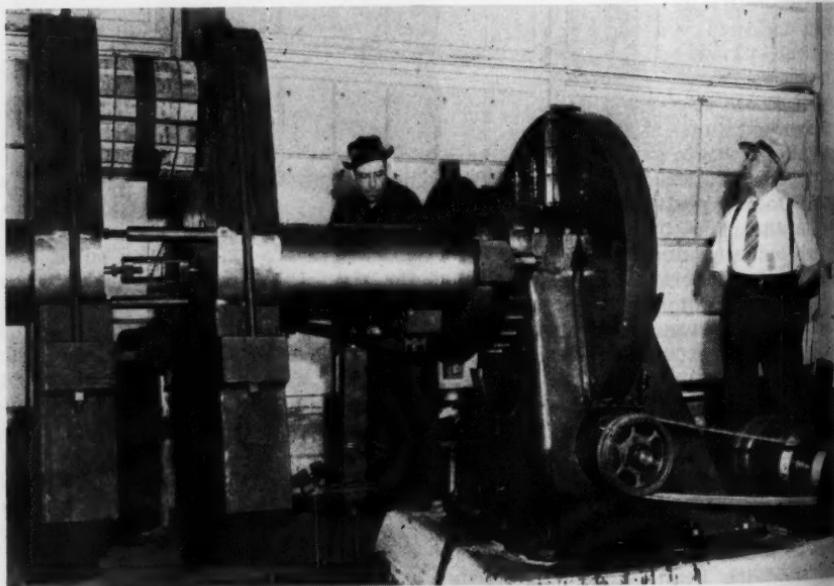
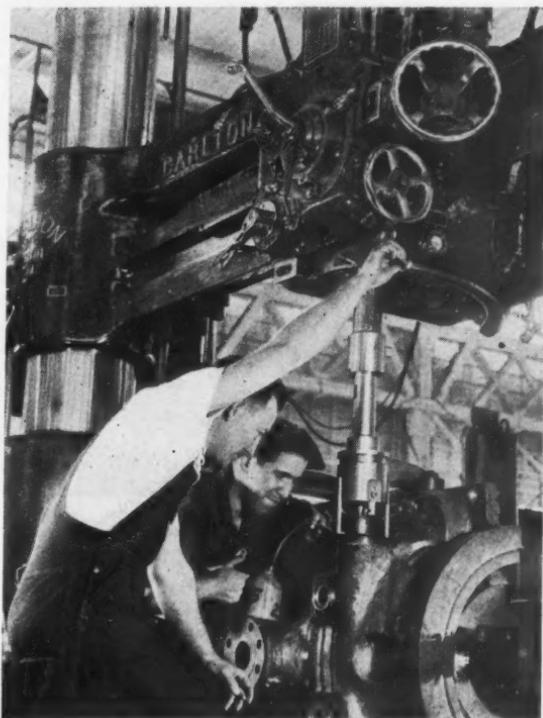


Fig. 18—Using a Radical Drilling Machine and Collapsible Tap to Tap the Steam Intake Valve on a High Pressure Cylinder for an 8,500 H.P. Steam Turbine



having the power necessary to drive such a large tap, it has practically instantaneous control in all directions.

Instead of using the conventional methods for cutting blade-ring grooves in the rotors of the low pressure cylinders for the 8,500 h. p. C-3 steam turbines, Hendy reverses the direction of the lathe spindle and sets the cutting tools upside down as shown in Fig. 19. This method has several advantages; it makes the cut immediately visible to the operator, it tends to eliminate chatter and to steady the work, it frees the tool from the weight of the spindle

and prevents "digging in," and it allows the chips to fall away instead of piling up above the tool in position to damage the work.

The 14 grooves to be cut vary in depth from $\frac{1}{4}$ inch to 2 inches and

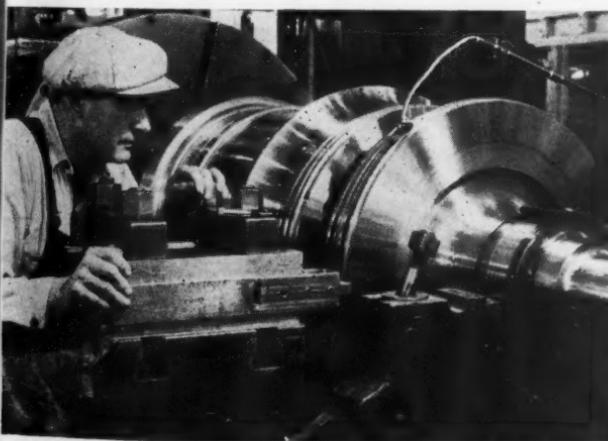


Fig. 19 — To Cut Blade-Ring Grooves, the Tools are Set Upside Down and the Lathe Spindle is Operated in Reverse Direction

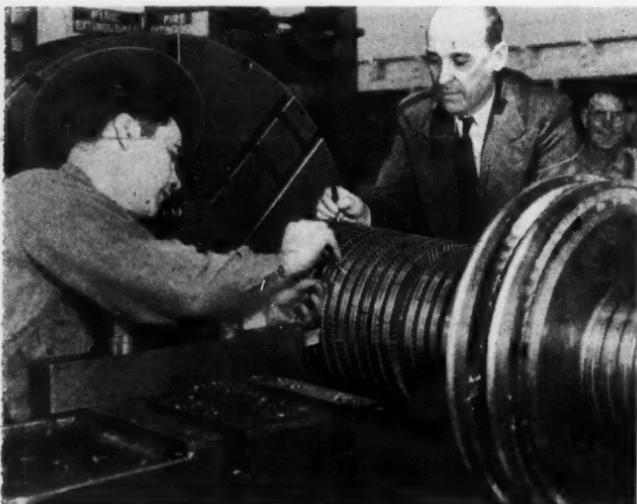


Fig. 20 — Machining Shroud Strips on a High Pressure Turbine Spindle to the Correct Width. Extreme Accuracy is Necessary so that Steam may be Conserved

in width from 0.289 inch to 0.876 inch, with varying widths of undercuts. High speed steel is used for the tools used to cut the straight groove, step groove and undercut. The undercuts are both roughed and finished, but for the straight and steep cuts, use of finishing tools alone has proved highly successful in obtaining accuracy and finish.

Due to the high speeds at which the spindles for the steam turbines rotate, it is necessary that every spindle be in perfect balance before it is assembled to its engine.

The balance is tested by running the spindle at operating speed while it is supported in two floating bearing that are set on knife edges in the bearing column. In principle, the balancing machine consists of a motor, a set of reduction gears, a shaft, the two floating bearings, arms leading from the bearings to pickup coils in which impulses are set up by the movement of the arms, and specialized electronic devices which record, segregate, and analyze the impulses as a basis for computations by which corrections will be made.

The balancing process is usually begun by adding a known unbalance

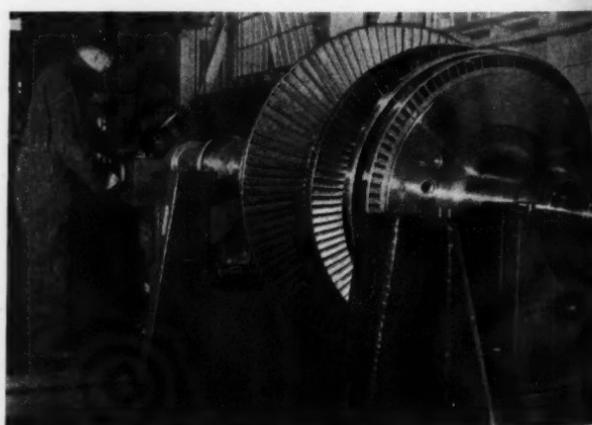


Fig. 21 — Testing a Spindle for an 8,500 H. P. Steam Turbine for Balance. This Machine Locates the Exact Point of Unbalance

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for

KNOOP HARDNESS NUMBERS

*See it at the
Metal Show*

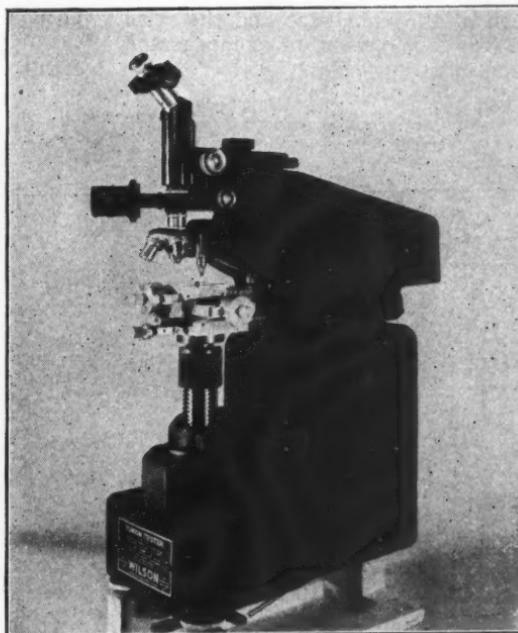
THIS is a new instrument for micrometric tests of hardness made by the sole manufacturer of "ROCKWELL" Testers and "ROCKWELL" Superficial Testers.

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The long diagonal varies with hardness and load from 20 microns to 1000 microns and depth of indentation is about $1/30$ of long diagonal, so truly surface hardness can be measured.



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ancing weight to the component to be balanced—say three ounces—and setting dials and scales against this known figure, which provides an index for subsequent checking of the unweighted piece. The electronic devices, reacting to the impulses of the pickup coils, report the exact location of the unbalance and the result of the application of compensatory treatment.

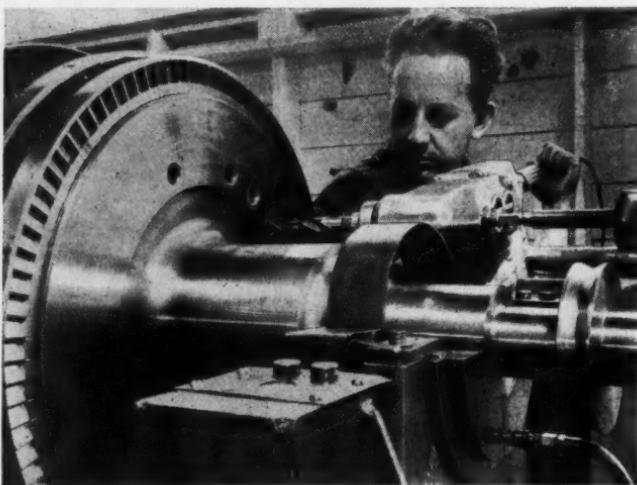


Fig. 22—The Exact Amount of Metal that should Be Removed to Balance the Shaft is Removed by Drilling with the Equipment Shown Here

Frequent checking of the dimensions of the shroud strip on a high pressure spindle for a C-3 turbine, as shown in Fig. 20, is a part of the process of facing the shroud strips to specified widths so that the proper clearance can be guaranteed as they revolve at close to 6,000 r. p. m. between the fixed blade rings in the cylinder casing. Extreme accuracy is essential since clearances are kept very small in order that all possible steam energy may be utilized. This is one of the final processes before the balancing of the spindle.

In the illustration Fig. 21 a low pressure spindle for an 8,500 h. p. C-3 steam turbine is shown undergoing a balancing test in one of the three dynamic balancers in the Hendy machine shop. This machine has a capacity of from 2 to 12½ tons; the other two handle work of from 130 pounds to 1½ tons and from 0 to 1,000 pounds. The smallest one is so sensitive that it picks up unbalance of as little as 0.000025 ounce though most of the balancing averages to 0.01 ounce.

After the degree of unbalance in a part has been computed on a dynamic balancing machine of this type, and the location of the point of unbalance has accurately been determined, the balancing process is in a basis of right and left-hand planes. A drill is used, as shown in Fig. 22, to remove

the exact amount of metal required from the right plane of the spindle along a previously-indicated correction line, and the balance is then further corrected on a similar line on the left-hand plane surface of the spindle, the process being continued until a dead balance down to 1/100 or better is obtained.

In the case of large gears, unbalance is compensated by adding carefully-calculated amounts of metal plate to the inside of the fabricated wheel. Rotors are meticulously balanced when blading starts, but



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Fig. 23—Stand for Testing Turbo-Generator Sets. Eight Sets may be Tested Simultaneously on this Stand

addition of the multiple rows of blades with spacers, locking devices, and shroud strips, plus the riveting of the shrouds, inescapably sets up variations in balance which must be adjusted, despite the exacting care which has gone into the machining of all the parts.

All rotors and gears (with the exception of the 147-inch C-3 turbine bull gears) are balanced on these machines. In the case of rotating parts for the 300-kw turbo-generator sets, the individual basket wheels of the spindle are statically balanced, but when the spindle is assembled on its shaft and joined with the pinion-gear spindle (which has already been dynamically balanced), the whole assembly is placed on the machine for final balancing.

Testing of the spindles and larger gears is usually done at a speed of 300 r. p. m. instead of at the known critical speed. Since the same elements of flutter or vibration are present at 300 r. p. m. as at the critical

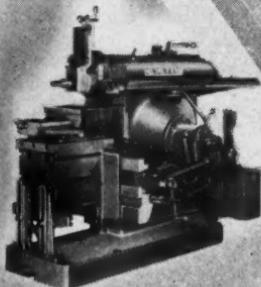
speed (say 5,000 r. p. m.), the same effect may be achieved at the lower speed by electronic amplification of the minute impulses. Smaller parts are tested at an average of 400 to 500 revolutions per minute.

Eight turbo-generator sets may be tested simultaneously on the test stand shown in Fig. 23, which also has facilities for the testing of large main-propulsion engines. Sets are run at full load with a special testing and checking of all safety devices actual operating conditions being reproduced in every respect. The special boiler supplies steam at 400 pounds pressure and 750 degrees superheat. It can, however, produce pressure up to 1200 pounds. Hendy-built turbines are put through a regular sequence of operations and must prove themselves under conditions far more severe than those they can normally be expected to encounter in service. In consequence, Hendy has established an enviable reputation as a builder of dependable engines.

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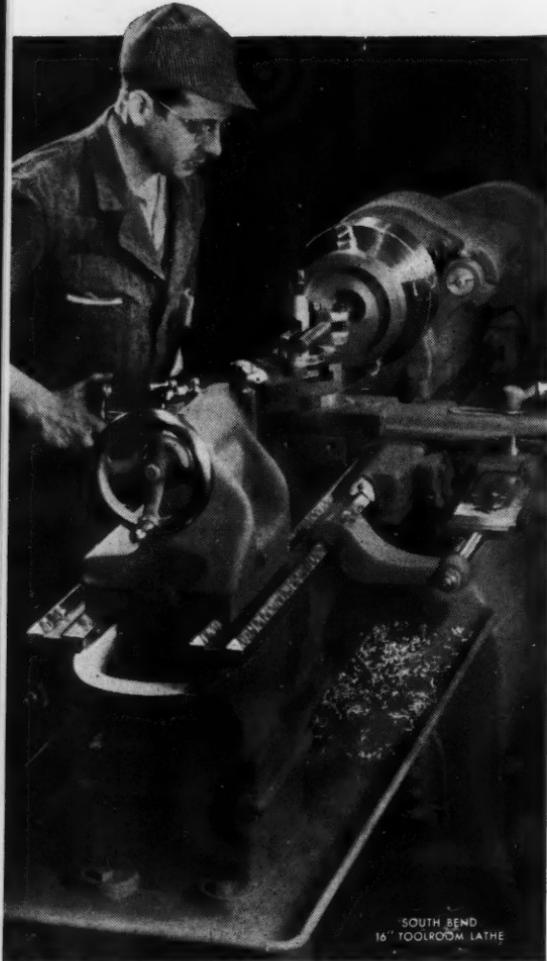


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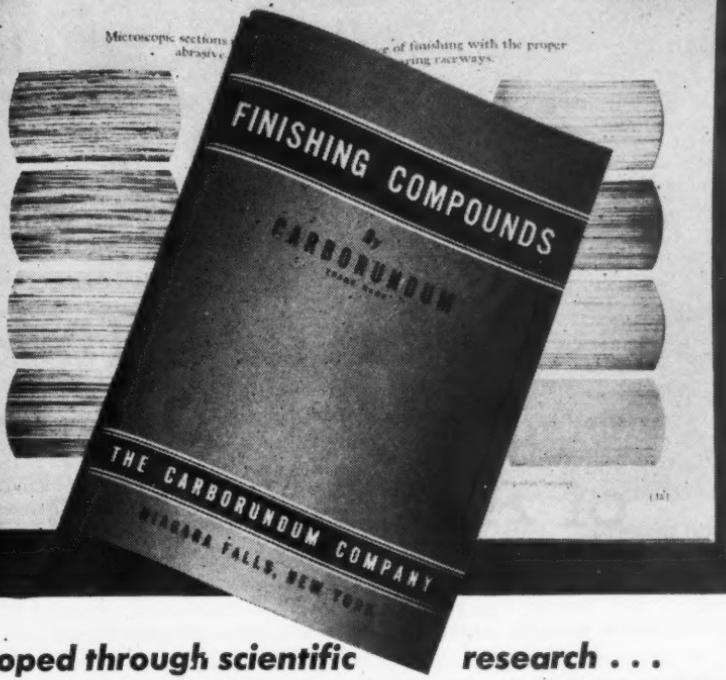
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October, 1944

MODERN MACHINE SHOP 137



"Wilder Wildcat" Carrier-Based Navy Fighter Plane built only by Linden Division
of General Motors Corporation

Use of Negative Rake Tools in Production of Aircraft Parts

By J. Q. HOLMES*

Master Mechanic, Eastern Aircraft Division, General Motors Corporation,
Linden, New Jersey

EASTERN Aircraft is one of General Motors' newest divisions. It was formed in January 1942 for the sole purpose of producing planes for the United States Navy. The personnel was recruited from many of the Corporation's other divisions. In all, 47 plants were called on for men. They came from plants from the Pacific to the Atlantic Coasts. These men had no aircraft experience prior to the start of this project. However, they were experienced in manufacturing problems. With these men for a start, people were hired and the personnel built up.

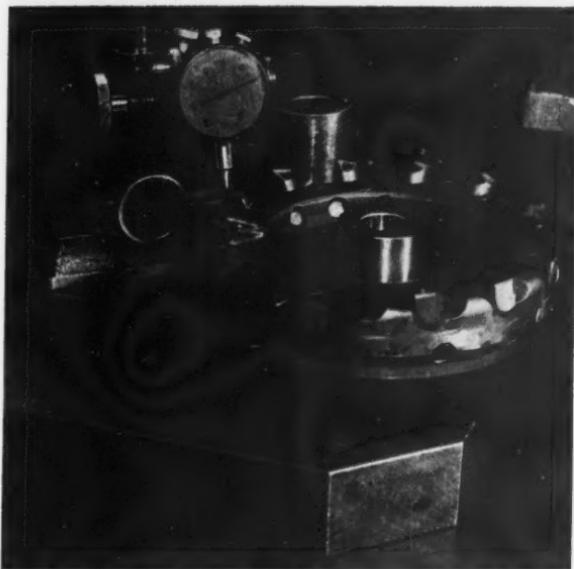
The Linden Plant, with which the speaker is connected, builds the

"Wilder Wildcat"—or FM-2—as it is designated. This is a carrier-based folding-wing fighter plane produced exclusively by General Motors. The Wildcat is built completely by Eastern Aircraft with the exception of government-furnished parts such as engine, guns, radio and so on.

Because of the high stresses in this product almost all structural parts that require higher physical strength than can be obtained with Aluminum Alloys are made from Chrome Molybdenum Steel such as 4130-4140 and Chrome, Nickel, Moly Steel such as 4340. These parts are machined in three conditions; namely, annealed, normalized and heat-treated.

* Read at semi-annual meeting of A.S.M.E., Pittsburgh, Pa., June 20, 1944.

Inspection of Finish-Ground Cutters. Teeth are Held to Uniform Length Relative to the Mounting within 0.0003 to 0.0005 Inch



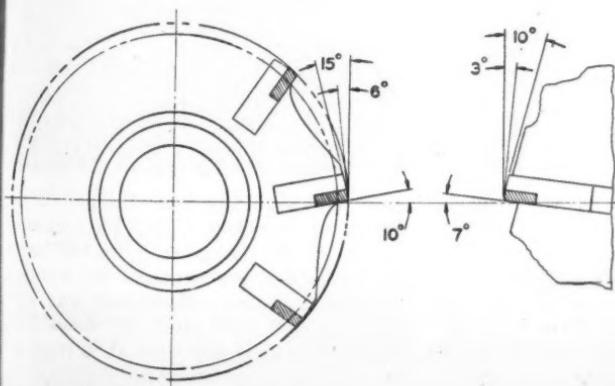
The annealed runs	100,000
	17 C Rockwell
The normalized runs	120,000 PST
	24 C Rockwell
The heat-treated runs	180,000
	40 C Rockwell

This discussion basically deals with the machining of those steels. The condition in which the pieces are machined is determined by the use, the limits to be held and the amount of warpage that develops as a result of heat-treating.

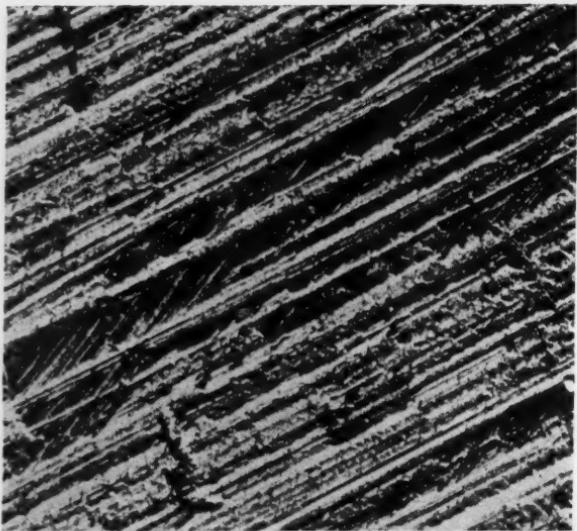
Negative rake cutting was investigated late in the year 1942. One of the manufacturers of tungsten carbide told us of the performance of such tools and left us a circular describing the method. Of course, our first reaction was typical: "We knew

it couldn't be done." However, one of the first things we were told in airplane work was that "one didn't have to be crazy to build planes, but it surely helped," and having learned that many new ideas would work, we decided to order a milling cutter of the negative-rake type.

Following the recommendation of the carbide manufacturer we ordered one 6-inch diameter inserted blade face mill with negative helix and negative rake. The cutter manufacturer at once "knew" we were screwy and



Drawing of Typical Grind Used on Negative Rake Milling Cutters. A Print of this Drawing is Posted in the Grinding Room for the Guidance of Operators



(Above) — Micro-Photo of the Finish Obtained by Conventional Milling on 4130 Steel, X10

(Below) — Finish Obtained with Negative Rake Tools on 4130 Steel, X10



advised us they could make us such a cutter "if we wanted it," but politely questioned its design stated that, if made, no such cutter would be guaranteed. We assured them that we did want this cutter and would not hold them responsible for its performance.

When the cutter came in, the representative of the carbide manufacturing company came in to see it tested. The test was run on a No. 5 Milwaukee Vertical Mill, which was selected because it was one of our heavier machines. At his recommendation, cutter speed was set high but the feed per minute was only a

floor was smoking from the hot chips. When we reached a then phenomenal speed of 1000 feet per minute and feed of 21 inches per minute, we decided to call it a day. This test was run on annealed 4130 steel which we had been milling every day at a feed of $1\frac{1}{2}$ inches per minute.



JOBS WELL DONE on the

ILLINOIS DIE FILING MACHINE

1 - FILEING

Designed for filing of intricate die shapes...table can be tilted to right or left up to 30° from horizontal plane. Quick and easy.



2 - SAWING

The blade has a remarkable cutting action to those intricate shapes of dies up to 6" length and 6" width recommended. Dies may be held in a vise or held by hand.



3 - FITTING

A unique vise can be inserted easily and quickly without any tools. This vise can hold any eccentric mechanism that performs those more production jobs: filing, fitting and sawing.



RAPID AND ACCURATE PERFORMANCE OF CRITICAL FINISHING OPERATIONS

PRECISION and BALANCE mark the Illinois Die Filing

Machine which is designed to save time and do a superior job on finishing intricate die shapes. Convenient and adaptable, it is built with extreme precision and durability. Working parts are hardened and ground for accuracy and long life. Automatic forced feed lubrication reduces wear to a minimum. The Illinois Die Filing Machine relieves tedious hand filing of intricate shapes and assures greater accuracy at lower cost.

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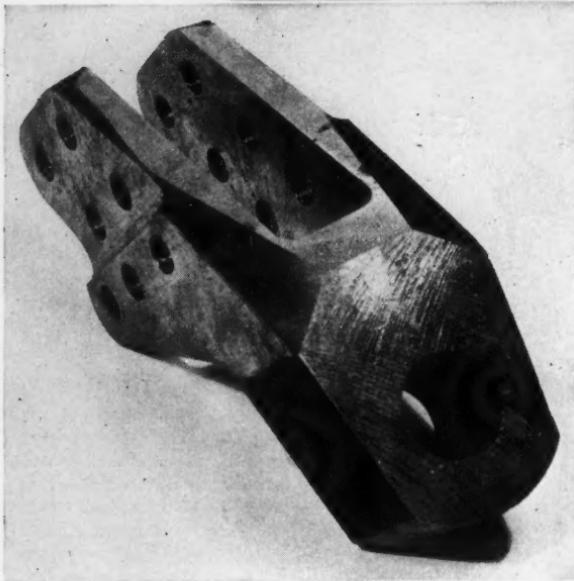
ILLINOIS TOOL WORKS

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In Canada: Canada Illinois Tools, Ltd., Toronto, Ontario.

MANUFACTURERS OF METAL CUTTING TOOLS AND SHAKEPROOF PRODUCTS

Set-Up for Machining a Wing Hinge Fitting.
Material, 4130 Steel;
Tensile Strength, 105,000 PSI. Run on a No. 5 Vertical Mill; Speed, 400 RPM; 838 SFPM; Feed 21 IPM; CPT 0.00375; Depth of Cut $\frac{1}{8}$ Inch; Width 3 inches; Length 5 Inches. Number of Pieces Per Grind, 119. Carbide-Tipped Tools, Ground with Negative Rake. With High Speed Steel, 37 RPM; 77.5 FPM; 2 IPM; 0.004 CPT. Same Depth and Width of Cut, 97 Pieces Per Grind. HP Required, 13.4 at 21 Inch Per Minute Feed



The results of this test proved to us that we really had "something;" what, we didn't know. It was decided to use this cutter and find out if this was an application of a really usable tool. Weeks of test continued. Different grinds were tried; tips were broken and replaced, proving one

Photograph of Finished Wing Hinge Shown in Work in the illustration above. Note that Surface Around Hole Cut with High Speed Steel Producing Conventional Finish. Speed 12 RPM; 41 SFPM; 7/16 IPM; 0.0014 CPT. Soluble Oil Used. Surfaces Adjacent to Slot Were Machined with Negative Rake Cutter Using No Coolant. Speed 326 RPM; 1024 SFPM; 9 IPM; 0.0007 CPT; Depth of Cut $4\frac{1}{2}$ Inches; Width $\frac{1}{2}$ Inch; Length of Cut 4 Inches

thing — inserted blade cutters were desirable.

While this test work was taking place, economic problems arose. Machinery was scarce

and delivery of new machines slow. Our production schedules were increasing. The Navy wanted more—always more. Man power was scarce too, and often when a man had been trained to a point where he was producing, we would lose him to the draft.

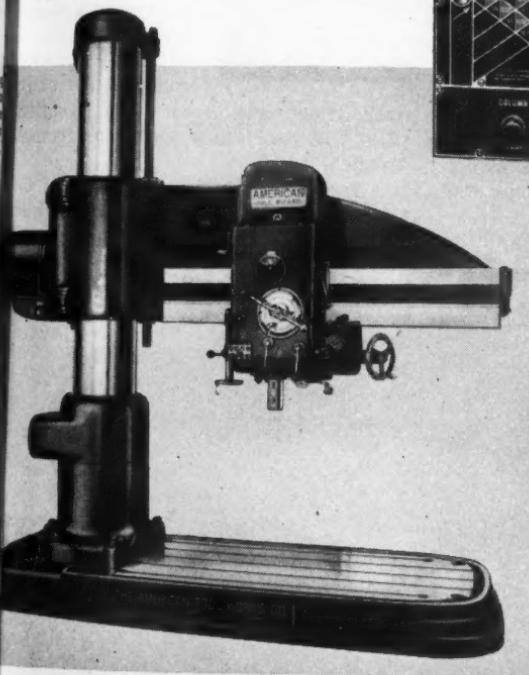
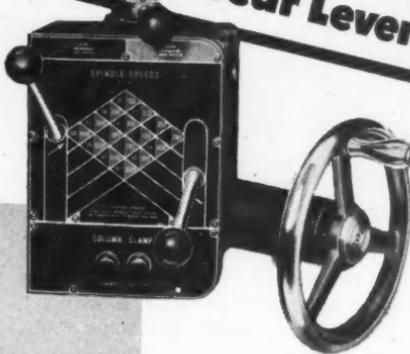
All these problems proved to us

32 SPINDLE SPEEDS

Operators are enthusiastic in their praise of this new direct reading speed control. They don't have to refer to index plates or retain over positions in their minds when making speed changes. Its superiority and convenience encourages operators to use correct speeds for their work. Being direct reading, operators are not fearful of making mistakes.

The entire range of 32 spindle speeds is secured through two opposed vertically operated

*...with only
2 Control Levers and
1 Back Gear Lever*



levers which are direct reading and one two-position back gear lever used only when changing from the high to the low speed range or vice versa.

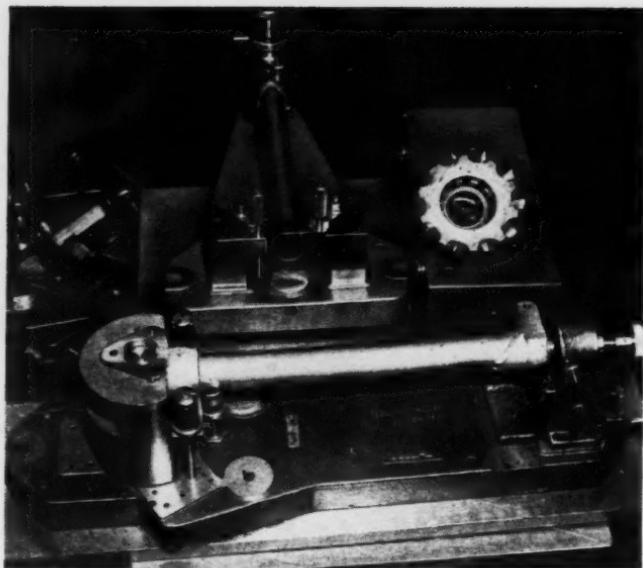
This new speed control makes work easier; increases production because of it and the payroll dollar buys more as a consequence.

This and other fine features of the "American" Hole Wizard Radial Drill are thoroughly illustrated and described by Bulletin No. 326.

THE AMERICAN TOOL WORKS CO.

Cincinnati, Ohio, U. S. A.

Lathes and Radial Drills



Fixtures and Cutters Used for Machining Landing Gear Box Material, 4130 Steel; Tensile Strength, 40,000 PSI; Operation Face Milling; Two Surfaces Shown. Negative Rake Carbide-Tipped Cutter; Speed, 400 RPM; 833 SFPM; Feed, 21 IPM; 0.0005 CPT. Depth of Cut, 3/32 Inch; Width of Cut, Length, 3 x 3 inches, 158 Pieces Per Gage. This Operation Required 4 HP with Sharp Cutter and 10 HP with Dull Cutter.

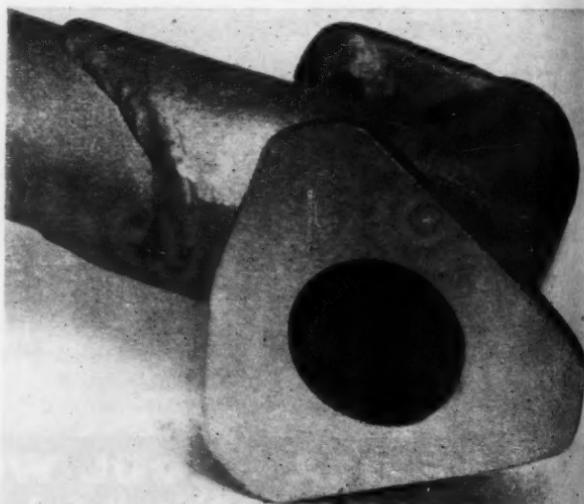
that if parts could be run in production at the speeds found satisfactory in tests, we could produce more on our existing machines and tools and use less man power.

Our tests had shown us another desirable improvement — Finish! While we do not need the finish required in aircraft engine work, a good machined

over those produced with positive rake. In fact, they look like ground finishes.

All of these findings convinced us that we should put this new method into production. Please keep in mind

Close-Up Showing Milled Surfaces of One End of Part Shown in Previous Illustration. This Part was Designed for Heavy Stress, Being an Assembly of a Chrome-Moly Forging and a Piece of Tubing Welded Together and Heat Treated. The Milled Surface is Held to 0.0015 inch with Respect to the Milled Surface on the Opposite End.

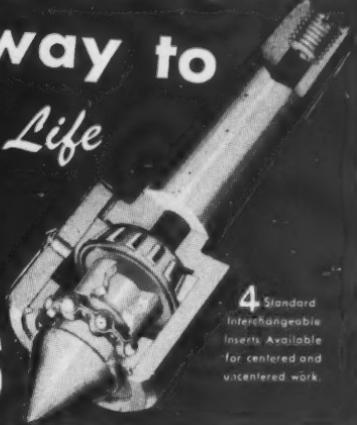


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Pointing the way to Longer Tool Life

IDEAL

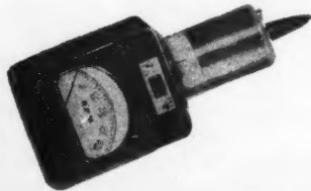
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Interchangeable
Inserts Available
for centered and
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Increase Tool Life—Handle heavier loads—permit deeper cuts at higher speeds because they rotate with the work. Built for precision jobs. Where standard inserts cannot be used, special inserts may be made to suit the requirement. Centers with Morse tapers carried in stock.

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Effective for checking all machine and tool speeds. Equipped with a wheel for measuring surface speed in feet per minute. "Hand" Type and "Separable" Type. Two Ranges—0 to 2500 RPM and 0 to 5000 RPM.



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A single pass across the Demagnetizer removes metallic dust, flakes, fine chips, etc. Keeps Tools Sharp Longer. Powerful—Portable. Two sizes.

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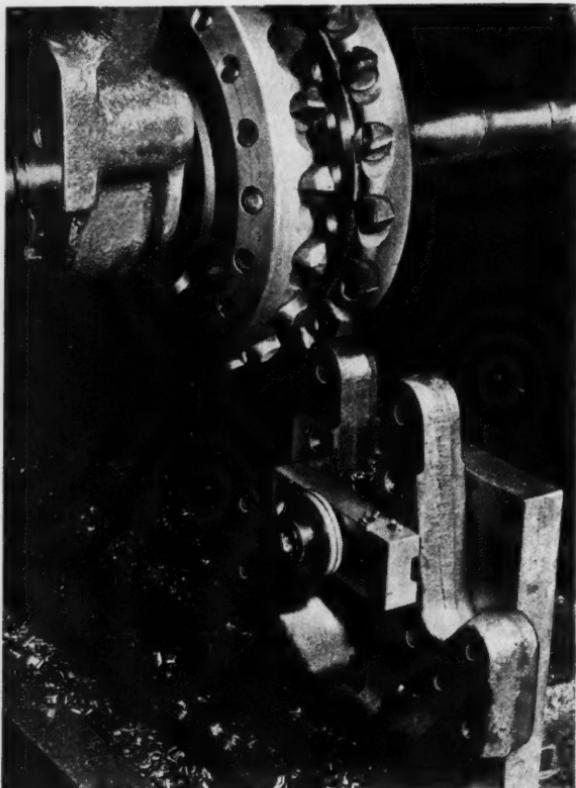
IDEAL COMMUTATOR DRESSER CO.



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Sales offices in all principal cities. In Canada: Irving Smith Ltd., Montreal Quebec.



Close-Up of Straddle Milling Operation on a Lock Fitting that Holds the Folding Wing in Position. This Part is Extremely Important. Material, 4140 Steel; Tensile Strength, 105000 PSI. Fixture Shown was Too Light for Job; Fixture has Since Been Rebuilt. Cutter, Carbide Tipped, Negative Rake. Speed 247 RPM; 623 SPM; 15 IPM; 0.0030 CPT; Depth of Cut $\frac{1}{8}$ Inch; Width $1\frac{1}{4}$ Inch; Length $1\frac{1}{2}$ Inch. Pieces Per Grind, 100

the feed would be reduced.

We now have about thirty jobs running with negative rake tools, including milling, turret lathe and precision bearing work, some of which will be shown a little later in this discussion.

The milling operations are face milling, straddle milling and slotting of steel. To date no tests have been run on slab mills, the reason for this being that the cutters are

quite difficult to tip with carbide. All of these milling jobs have shown remarkable increases in production. Feeds have been increased from a range of $\frac{1}{8}:2$ to $5\frac{1}{2}:30$ inches per minute. Ratio of decrease in cutting time is 10:15 to one. In fact, cutting time has been reduced to such a point that it is but a small part of the total time required on an operation.

To really take maximum advantage of this cutting speed, automatic loading or indexing fixtures should be built. We have not gone into this as aircraft production does not justify such tool expense. However, the information gained will be of great value in automotive tooling.

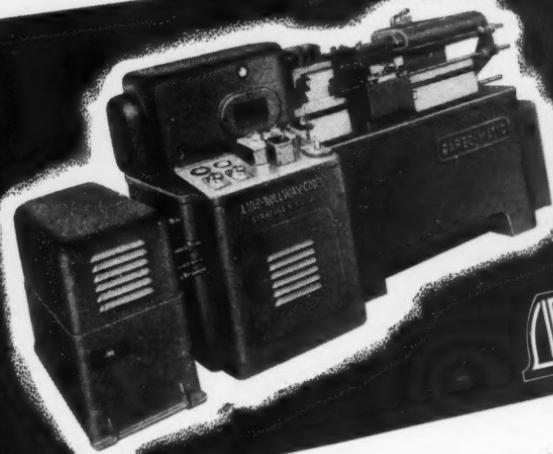
The turret lathe jobs are turning

that our sole reason for existence was to build more planes for the Navy and build them always better. We were not interested in the development of a new method, either from a sales angle or from a problem in research or engineering. Just one thing—to get the "most of the best for the least."

The adoption of such a program met with considerable resistance. Our people thought that such speeds were merely stunts. At first our operators were afraid, due to the large quantity of hot chips that flew from the work. The use of Safety Goggles was required. Speeds and feeds would be maintained while the Tool Engineer was present, but as soon as he left,

SPEED → PRECISION ECONOMY

... PLUS HYDRAULIC
VERSATILITY FOR QUICK
CHANGE-OVER TO NEW PRODUCTS



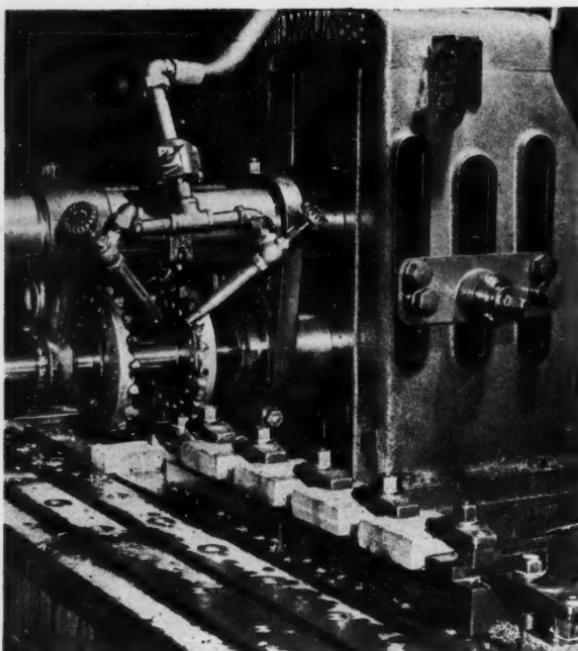
With automatic
hydraulic
holding equip-
ment, feeds, tail-
stock quill. Swing
over bed 15", over
carriage 8", be-
tween centers 30".

Designed especially for carbide tools, the Lipe Carbo-Matic Lathe gives you full advantage of modern "man-made diamond" cutting tools. It has the rigidity and brute power for fast, heavy hogging or intermittent cuts on high brinell steels . . . the high spindle speeds for efficient precision finishing to tolerances as close as .0005" . . . and the automatic "know how" which carries a cycle to completion without help from the operator. Labor costs, tool costs and scrap costs are lower. Adjustment, cleaning and re-setting are simpler.

It has the versatility for quick change-over to new products or parts. Feed rates, traverse rates and sequence of motions are hydraulically controlled, permitting almost infinite variation. Speed changes range through 198 different steps from a low of 59 to a high of 3,100. It is a lathe you can rely on . . . a lathe that will give you the very qualities you'll need most in a post-war world of change, obsolescence and new products.



LIPE - ROLLWAY
CORPORATION
SYRACUSE 1, N. Y.



Straddle Milling Operation on Wing Reinforcement Angle, Using Negative Rake Cutters. Speed, 200 RPM; 471 SFPM; Feed 20 IPM; 0.0095 CPT; Depth of Cut, $\frac{1}{8}$ Inch; Width 1 $\frac{1}{4}$ Inch; Length 4 $\frac{1}{2}$ Inch. Pieces per Grind, 144. Note that This Machine is Running at Much Lower Speed than Other Operations Described, which is Due to Fact that 200 RPM is Maximum Speed Obtainable with Present Gears. New Gears Have Been Ordered. All Surfaces on These Parts were Machined on a No. 5 Vertical Mill, Using a Negative Rake Cutter at 400 RPM; 838 SFPM; Feed 25 IPM; 0.0045 CPT; Depth of Cut $\frac{1}{8}$ Inch; Width 1 $\frac{1}{2}$ Inches; Length 4 $\frac{1}{2}$ Inches. Number of Pieces Per Grind, 149. 138-Pound Flywheel Was Used on Spindle. This was the Only Job Run with a Coolant When Using Negative Rake Tools, Coolant Being Desirable in this Set-up Because of the Slow Speed.

and facing. As shown in the illustrations, these jobs often involve intermittent cuts. Cutting time has been reduced, however, since these jobs are running two to four times faster with feed increases of two to three times. Speeds of 400-500 SFM are used with feeds of 0.009 inch per minute compared with 0.003 inch. Several parts that were previously ground are now bored on Heald Bore-

matics. Many of these parts are about 40 Rockwell "C."

The grinding of tungsten carbide tools for this work must be done carefully. We have found by test that the best angles for our work are 7 deg. negative helix and 10 deg. negative rake, on face mills, and all our milling cutters are ground to these angles. It is imperative that these cutters be finish-ground with

... for more than 1001 odd jobs



HJORTH LATHE & TOOL CO.

The Hjorth Bench Lathe has the speed, accuracy, handling ease, and dependability that appeals to every operator. That's why you'll find the better shops equipping with the Hjorth Lathe.

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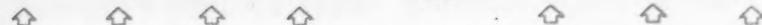
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READY TO "TALK TURKEY" ON ROTARY FILES



WITH Rotary Files, the world's foremost file manufacturer now extends still further the scope of the well-known Nicholson slogan, "*A file for every purpose.*"

After thorough study of the fast-growing uses of Rotary Files, Nicholson is prepared to provide both *Hand Cut* and *Ground-from-solid* types.

Each type is available in 16 standard styles or shapes; 3 cuts (Coarse, Medium and Fine); 64 sizes and in diameters $\frac{1}{8}$ " to 2".

For easy identification, each file shank

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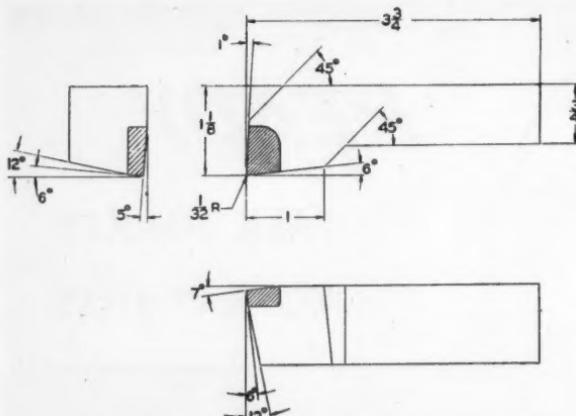
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Write us for any special information. For deliveries, consult your mill-supply house.

Nicholson File Co., 48 Acorn St., Providence 1, R. I., U.S.A.
(Also Canadian Plant, Port Hope, Ont.)

NICHOLSON FILES FOR EVERY PURPOSE





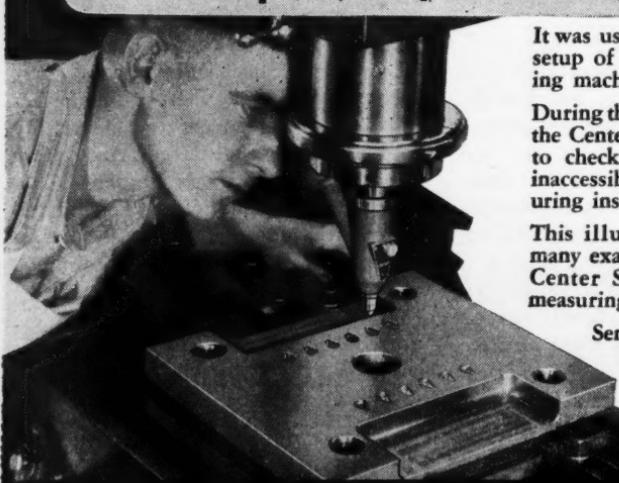
Drawing Showing Typical Grind for Carbide Tipped Facing Tool of the Type Used on Turret Lathes. Note Negative Side Rake and Negative Back Rake

diamond impregnated wheels. If Silicon Carbide is used, the wheel breaks down before the cutter is finished, and the teeth are of unequal length. With diamond wheels the teeth are held to the same length within 0.0003 to 0.0005 inch. After grinding, cutters are inspected to see that this

dimension is held. Spindles must run true and the cutters must be checked for un-out after mounting on the machines. While the same problem is not encountered with lathe tools, we rough-grind with Silicon Carbide wheels and finish with diamond wheels of 180 grit.

The grades of carbide used play an important part in the performance of the tools. We have used two grades; one for milling and turning, and another for facing when intermittent

Center Scope Accuracy Solves Locating Problems!



It was used in making the initial setup of this job on a die sinking machine.

During the machining operations, the Center Scope was again used to check dimensions that were inaccessible to mechanical measuring instruments.

This illustration is but one of many examples of the use of the Center Scope in locating and measuring to a .0001" accuracy.

Send — today — for complete information. Just write Dept. C. S. 2 for complete details.

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**WHEN THIS → DREW A BLANK
THE BOSS TORE HIS HAIR
UNTIL SOMEONE WISED HIM UP TO
THIS → THE RECESSED HEAD
SCREW THAT UPS → DRIVING
SPEED AS MUCH AS**

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Shankspeed Int'l., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Watervliet Bolt Co., Watervliet, N. Y.



Turret Lathe Setup for Machining Fittings Used on One End of Landing Gear Strut. Cutting Compound is Used on all Landing Gear Strut Operations on Which Negative Rake Tools are Used. Material: 4130 Steel in Normalized Condition. New Intermittent Cut Work Speed, 45 RPM; 356 SPPM; Feed 0.009 IPR; Depth of Cut $\frac{1}{4}$ Inch; Number of Pieces Per Grind 6.

Much has been written on the subject of tooth lead and number of teeth. Our work has been

cuts are made. Several makes have been tried and while we feel that there is a big field for tests on cutting grades, we are not doing much with it as we are getting excellent results from these two grades.

done with chip under 0.005 inch per tooth per revolution. At first, our speeds were higher than at present up to 1285 FPM with chip of 0.002 inch. Now we are running speeds from 800 to 1000 FPM and chip thickness up to

DESMOND GRINDING WHEEL DRESSERS



Desmond Hex Dresser



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Desmond Huntington Dressers

Our Desmond Huntington Cutters are made in all sizes.



We manufacture only complete line of dressers and cutters on the market, and will be glad to send samples for trial. Write for copy of our new catalog and name of your nearest jobber.

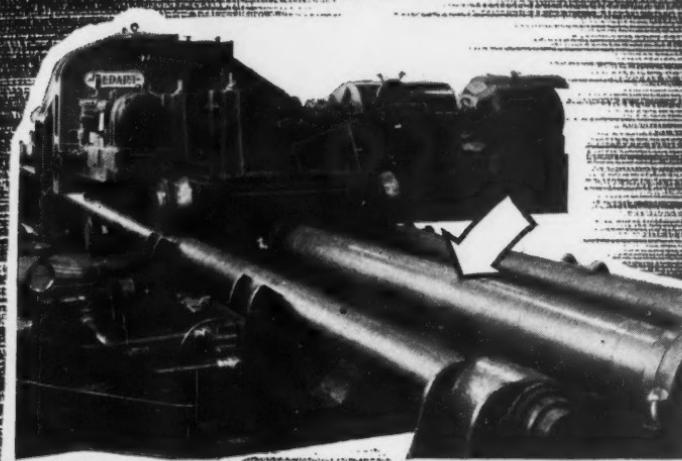


THE DESMOND-STEPHAN MFG. CO.

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Hydraulic Power for big jobs

This Medart Billet Peeler, capable of peeling or scalping round steel billets in sizes up to 13 in. diameter, uses powerful, easily controlled hydraulic action for clamping the billet in the carriage, and for advancing the carriage as the billet goes through the rotating cutter head. Hannifin precision hydraulic cylinders are used by Medart for both these applications. The carriage cylinders are an example of Hannifin ability to build large, long stroke hydraulic cylinders to precision standards. These cylinders are 11 inch bore x 144 inch stroke.

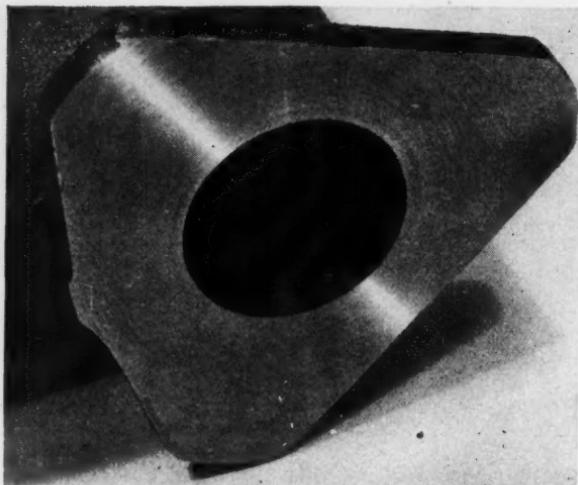
Just as in the smaller sizes, these cylinders are bored and honed to produce a mirror finish cylinder body—for maximum power, smooth action, and long life.

Bulletin 35 describes Hannifin hydraulic cylinders. Write for your copy. Hannifin Manufacturing Company, 621-631 South Kolmar Avenue, Chicago 24, Illinois.



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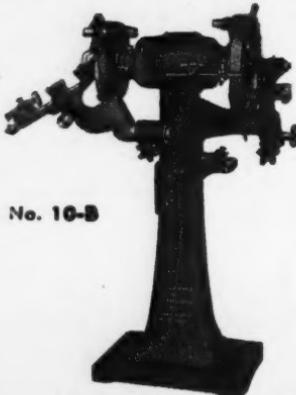
Close-Up View of Finished
Piece Shown in Operation in
Previous Illustration

0.0045 on milling. Most of our mill cutters are 6 inch diameter with 10 teeth or 8 inch diameter with 14 teeth. These have more teeth than many people think proper. Again

let me emphasize that we are getting excellent results — which are what we want!

In the examples to follow, comparison is made between carbide tipped milling cutters with negative rake and high speed steel with positive rake. You may ask what is the comparison between negative rake and positive rake cutters with the same grade of carbide? We have never made that comparison because we never have been successful in the use of carbide milling cutters with positive rake on steel.

GRAND RAPIDS Combination Tap and Drill Grinder MOTOR DRIVEN



No. 10-B

SHARPENS TAPS No. 6 to 1½"
2-3-4 Flute, Right or Left
Hand.

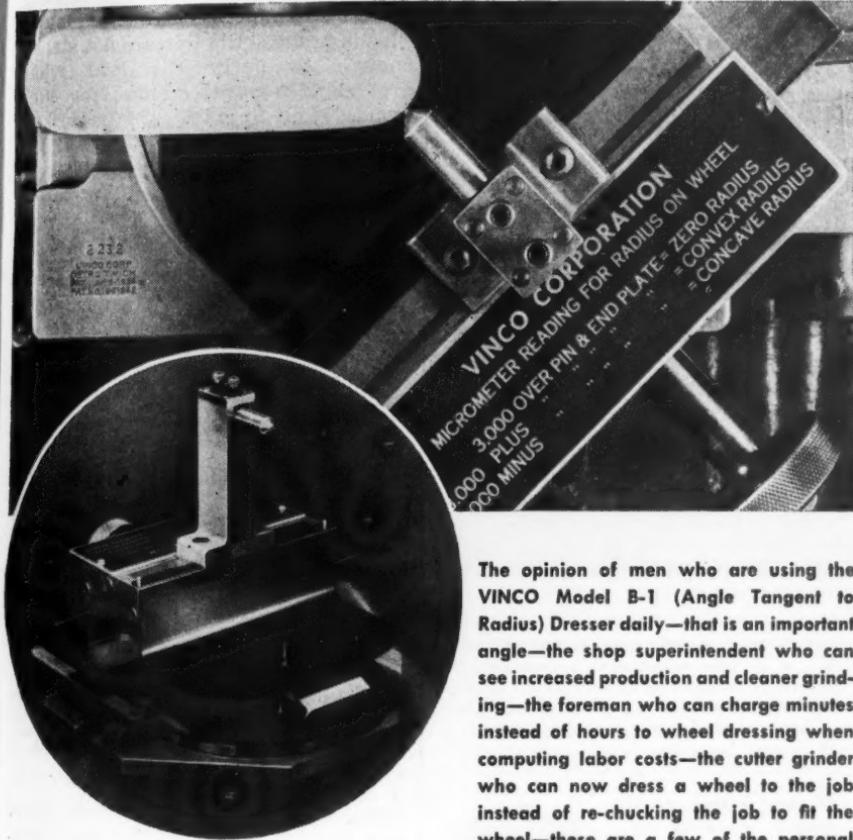
SHARPENS DRILLS $\frac{1}{8}$ " to 1½"
2 or 3 Flute, Straight or
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Other Combinations also
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Sub bases will be furnished (at slight additional cost) for most types of external and internal grinders. When ordering, specify the machine or machines on which the dresser will be used. This will enable us to advise you correctly on the type of base best suited to your specific needs.

The opinion of men who are using the VINCO Model B-1 (Angle Tangent to Radius) Dresser daily—that is an important angle—the shop superintendent who can see increased production and cleaner grinding—the foreman who can charge minutes instead of hours to wheel dressing when computing labor costs—the cutter grinder who can now dress a wheel to the job instead of re-chucking the job to fit the wheel—these are a few of the personal angles that are largely responsible for the rapid increase in the VINCO B-1 Dresser acceptance. Write us direct or consult our District Sales Offices for any further information.

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MARQUETTE A.C. ARC WELDER

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No other method equals electric welding for speed, quality and economy for tool and die fabrication.

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A.C. ARC WELDERS

The experience of the author and his associates over a period of years has been failure of carbide milling cutters with positive rake on steel. This is because the tips are not strong enough to carry the lead when ground with positive rake; for such grinds, High Speed Steel is more satisfactory.

Carbide has, of course, been used with positive rake in milling alumin-



Turret Lathe Set-Up for Machining Opposite End of Landing Gear Strut Shown in Previous Illustrations, Using Negative Rake Tool. Speed 475 RPM; 356 SPM; Feed 0.009 IPR; Depth of Cut, $\frac{1}{4}$ Inch; Pieces Per Grind, 69.

ium, and to date we do not know of a top limit of speed for this work. Our recent experiments on milling aluminum with negative rake indicate that it will be possible to use the same cutters for aluminum as for steel. The advantage of this is better finish and reduction of cutter inventory.

We have done some test work on chip loads up to 0.008 inch but find on our mills that the spindles are light for this load. We are using No. 3, No. 4 and No. 5 knee-type mills in most cases. An exception is a duplex mill on a straddle mill job.

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WHAT HAS THIS TO DO WITH BROACHING?



THE Alcan Highway, hurled through hitherto impenetrable forests, across mountains, rushing torrents and treacherous muskeg . . . all conquered by man and his machines . . . machines that owe, in great measure, their very existence to the elementary principle of the inclined plane. Used in ancient Egypt it enabled the engineers of the Pharaohs to move into position by sheer human effort the massive blocks of stone that formed the Pyramids. This same principle, upon development became the worm gear — that efficient instrument of power transmission — used in nearly every field of power application . . . without which our machine built civilization might well collapse.

EVEN as the principle of the inclined plane has influenced daily living in the widespread use of the worm gear, so also has Broaching, developed through successive phases from a crude beginning. Today, thousands of parts are made quicker, cheaper and better by modern applications of the broaching principle. In keeping with the trends of the past, even greater developments are in store for the world of tomorrow.



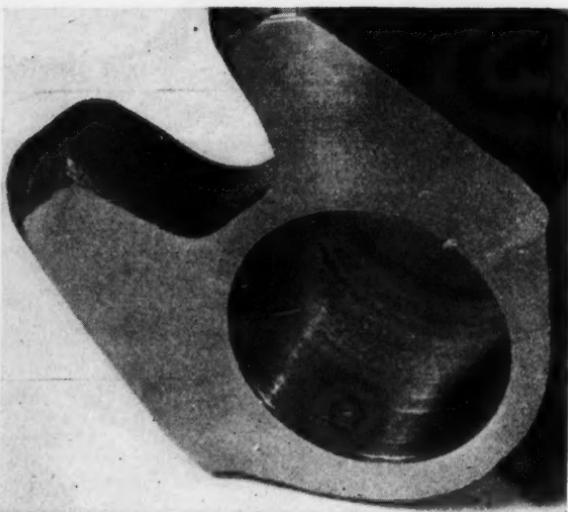
By driving steel balls, and later, crude drifts through the heated part . . . clever builders broached the hubs of the famed covered wagons.



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THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHES AND BROACHING MACHINES



Finished Part Shown in Work
in Previous Illustration. Note
Intermittent Cut

and have taken power readings.

A wide variety of parts were run on this machine and observations made of the power used. On the parts illustrated, the power consumption was of no consequence. Some of the readings are given in the captions to the photographs.

We found that a great deal of variation exists between dull and

sharp cutters. In many of the tests we found that a dull cutter required twice the horse power of a sharp cutter. On one of the tests a sharp cutter required 13.4 horse power motor, even this was not objectionable.

We feel that within the normal capacity of the machine, increase in power for negative rake milling is no problem. This is because with the greatly reduced cutting time, such load occurs for such a short period of time relative to the total time that the motor will carry the overload, if any, without any trouble.

This machine has a top speed of 200 RPM, but even with this we have increased our feed to 20 inches per minute over a previous 1 to 2 inches.

We are testing fly wheels on the cutter end of the spindle to see if heavier cuts can be taken. We feel that with heavier machines much more can be done than we have done with our present machines.

Many people have asked about power requirements. As stated before, we are using negative rake tools for production, not research. However, we have installed meters on a No. 5 vertical 20 h. p. machine

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INTERNAL THREADING AND BORING TOOLS

For holes from $\frac{1}{8}$ " upwards, 15 different sizes. The accurate thread angle is maintained through each sharpening until tool is entirely worn down. Small head-long cutting surface for regrinding.

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SAN FRANCISCO STORE: 1180 FOLSOM ST.



Experimental set-up to test negative rake milling on 24ST aluminum. No trouble has been experienced with positive rake tools on this material. Test was run with cutter ground to same negative rake angle as has been used in steel, and produced satisfactory results. One definite advantage of the negative rake tools on this type of work is the fact that the cutter forces the work down onto the fixture instead of tending to lift it, as is done with positive rake tools.

We have not had any trouble with our motors from heating or from over-load.

One interesting fact was found; namely, when we increased feeds as, for example, from 15 inches per min-

ute to 20 inches per minute on a given job, the increase in power consumed was negligible.

By this time negative rake tools have been accepted by both operators and foremen. They now are interested in seeing other jobs toolled and are receptive to the method.

In some cases it has had the effect of stimulating operators to higher speeds on other operations. More jobs are being changed to negative rake tooling as fast as tools can be provided. In this plant negative rake tools are no longer experimental.

A fool and his money are soon parted. If wise; buy Victory Bonds and have your money when you need it.

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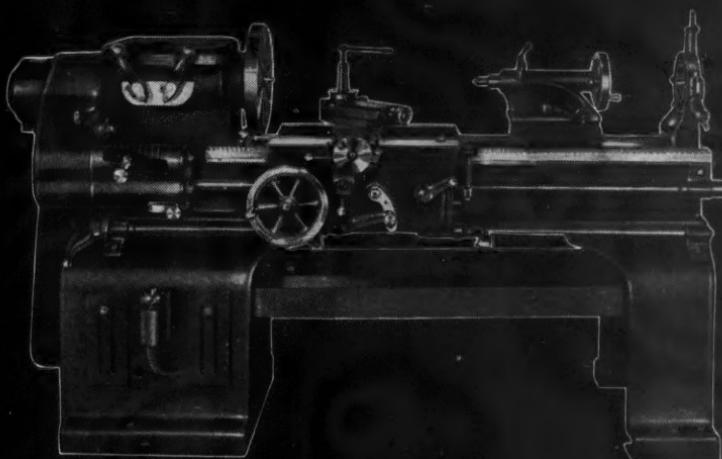
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QUESTION No. 1

Which INCO Nickel Alloy is FREE-MACHINING?

*Consult the tables below
for comparative properties of these two metals*

Answer No. 1...

TOUGH YET EASY TO MACHINE

Engineers and screw machine products manufacturers already know this metal. Introduced several years ago, "R" Monel offers the corrosion resistance, toughness and strength of regular Monel, plus improved machining characteristics.

Readily fabricated by cold forming, "R" Monel is available as hot-rolled and

cold-drawn rounds, squares and hexagons. This INCO Nickel Alloy is well suited for automatic production of rust proof screw machine parts, yet has mechanical properties at least equal to steel screw stock (SAE 1112), and is actually tougher.

PROPERTIES OF "R" MONEL

Condition	Tensile Strength 1000 psi	Yield Strength (0.2% offset) 1000 psi	Elongation in 2 in. per cent	Hardness BHN 10-mm. ball per cent	3000-lb. load
Cold-drawn, annealed ...	70-85	25-40	50-35	110-140	
Cold-drawn, as-drawn ...	80-115	50-100	35-15	150-220	
Hot-rolled, annealed ...	70-85	25-40	50-35	110-140	
Hot-rolled, as rolled ...	75-90	35-60	45-25	120-170	
PROPERTIES OF SAE 1112 STEEL SCREW STOCK					
Cold-drawn, as-drawn ...	80-100	70-80	20-10	170-200	
Hot-rolled, as rolled ...	60-80	35-55	40-30	126-150	

QUESTION No. 2

Which is free-machining and also HARDENABLE by HEAT TREATMENT?

Answer No. 2...

OFFER EXTRA HARDNESS AND STRENGTH

This metal is the latest addition to the family of INCO Nickel Alloys. Its name... "KR" Monel. Like "R" Monel, "KR" Monel combines corrosion resistance and strength with improved machining.

But "KR" offers a big plus . . . through heat treatment this un-

usual metal develops exceptional hardness and strength.

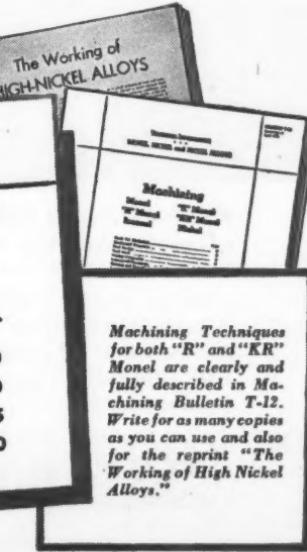
A non-magnetic alloy, "KR" Monel is suitable for production of corrosion-resisting parts, and can be heat-treated after machining.

For complete information on these and other INCO Nickel Alloys, write to:

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York, N. Y.

PROPERTIES OF "KR" MONEL

Condition	Tensile Strength 1000 psi	Yield Strength (0.2% offset) 1000 psi	Elongation in 2 in. per cent	Hardness BHN 10-mm. ball 3000 kg.
Cold-drawn, as-drawn . . .	100-125	70-100	35-15	175-250
Cold-drawn, heat-treated. 140-170	100-130	30-15	260-320	
Hot-rolled, as rolled.....	90-120	40- 85	45-30	140-225
Hot-rolled, heat-treated..	135-160	90-120	30-20	260-300



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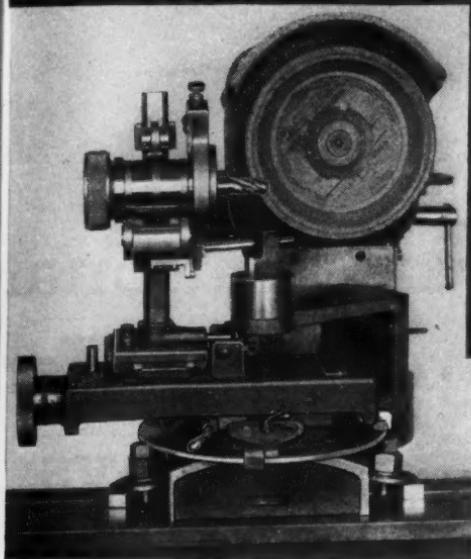
and Coolants satisfy shop requirements for low equipment maintenance costs and high speed precision output of machined products.

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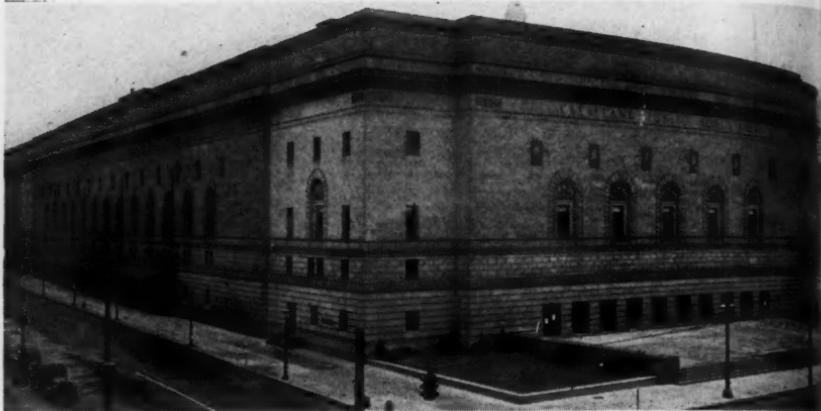
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26th Annual National Metal Congress and War Conference Displays

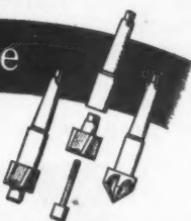
at Public Auditorium, Cleveland, Ohio,
October 16 - 20

MORE than 325 manufacturers, state and civic organizations are planning, for the 26th Annual National Metal Congress and War Conference Displays to be held in the Public Auditorium, Cleveland, Ohio, from October 16th to 20th, exhibits that range from ferrous and non-ferrous metals to processes and equipment for their production, fabrication, handling, treatment and use.

Sponsored by the American Society for Metals, in cooperation with the American Welding Society and the Iron and Steel and Institute of Metals

Divisions of the American Institute of Mining and Metallurgical Engineers the National Metal Congress this year will include the American Industrial Radium and X-Ray Society and the Society for Experimental Stress Analysis.

Altogether, some 150 lectures and papers will be presented by qualified authorities in the several branches of science and industry represented by these societies. The technical sessions of the American Society for Metals will be held at the Hollenden and Statler Hotels; the A. I. M. E. will be



Ever count the leaves on a tree? Of course not! But better look close at our picture. It is an accurate diagram of the combinations that can be made up out of the assortment of holders, cutters, and pilots contained in one Gairing Interchangeable Counterbore set. • For a wide range of counterboring, countersinking and spot-facing operations this adds up to great economy and efficiency. Expensive delays due to lack of proper tools are greatly reduced.



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GAIRING

the Statler; the American Welding Society will have headquarters at the Hotel Cleveland; the American Industrial Radium and X-Ray Society will



G. R. FITTERER
Campbell Memorial Lecturer

be located at the Hotel Hollenden, and the Society for Experimental Stress Analysis sessions will be held at the Carter Hotel.

In addition to the regular sessions of the National Metal Congress, the American Society for Metals will pre-

future interest to the metal industry.

Subjects that have been listed for specific discussion during the five days of sessions include: metal powders and products, metals for railroads, metallurgical furnaces, induction heating, heat treatment, manufacture of quality steels, national emergency steels, surface peening, foundry metallurgy, salt baths, sub-zero treatments, surface finishes and protection, new de-



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sent a series of practical panel-type afternoon and evening meetings on production problems of immediate and

developments in the study of corrosion, application of quality control instruments, metal cutting and tool materials and lightweight construction.

At the annual dinner of the American Society for Metals, to be held at the Hotel Statler on Thursday evening, October 19th, the Society will be awarded the Ordnance Distinguished Service Award in recognition of its contributions to the war effort through metals education and training work.

One of the outstanding contributions of the Society was the organization of scores of special advisory committees of metal executives and engineers to work with war materials manufacturers. The services of these consulting committees were free to producers of ordnance equipment and material.

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Programs of the Technical Societies American Society for Metals

(See also Schedule of Panel Discussion Meetings, Page 180)

MONDAY, OCTOBER 16

9:30 A. M.—Surface Hardening

Practical Aspects of the Selection of Frequency and Time Cycles for the Processing of Metallic Parts with Induction Heating, by W. E. Benninghoff and H. B. Osborn, Jr., Ohio Crankshaft Co.

Induction Hardening of Plain Carbon Steels, by D. L. Martin and F. E. Wilgus, General Electric Co.

Shot for Metal Peening, by O. E. Harder and J. T. Gow, Battelle Memorial Institute.

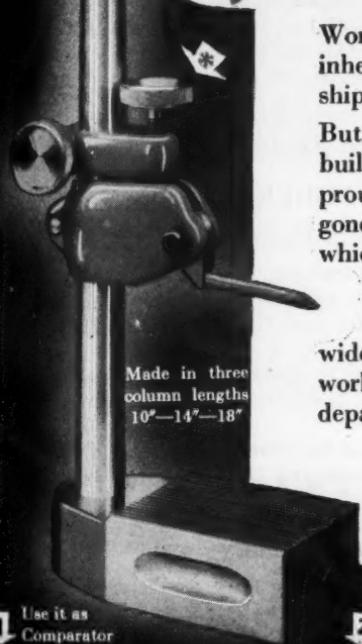
9:30 A. M.—Hardenability

Rates of Tempering in Cobalt Steels, by E. A. Loria, Carnegie-Illinois Steel Corp.
Isothermal Transformation and End-Quench Hardenability of Some NE Steels
by R. L. Rickett, J. G. Cutton, C. B. Bernhart, Jr., and J. R. Millikin, United States Steel Corp.

Further Developments of the End-Quenched Hardenability Test, by C. R. Wilkins, Earnshaw Cook and Howard S. Avery, American Brake Shoe Co.

A Hardenability Test for Low Carbon and Shallow Hardening Steels, by O. W. McMullan, Youngstown Sheet & Tube Co.

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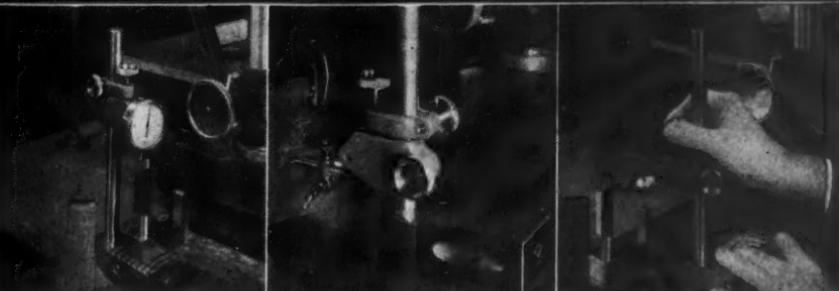
One turn of the adjusting screw moves the sliding member less than .006" for each revolution.

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1 Use it as
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2 Use it as
Scriber

3 Use it as
Height Gauge



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321N ALBANY STREET

SPRINGFIELD, MASS.

9:30 A. M.—Non-Ferrous Metal

- A Survey of Wrought Magnesium Alloy Fabrication**, by J. V. Winkler, DuPont Chemical Co.
- The Copper-Manganese Equilibrium System**, by R. S. Dean, J. R. Long, T. L. Graham, E. V. Potter and E. T. Hayes, Bureau of Mines.
- Properties of Transitional Structure in Copper-Manganese Alloys**, by R. S. Dean, E. V. Potter and J. R. Long, Bureau of Mines.
- Age Hardening Copper-Manganese-Nickel Alloys**, by R. S. Dean, J. R. Long, T. R. Graham and C. W. Matthews, Bureau of Mines.

11:30 A. M.—Victory Session Ballroom, Hotel Statler

TUESDAY, OCTOBER 17

9:30 A. M.—Physical Properties

- The Mechanism of Failure of 18 Cr, 8 Ni Cracking Still Tubes**, by C. L. Clark, Timken Roller Bearing Co., and J. W. Freeman, University of Michigan.
- Capillarity of Metallic Surfaces**, by E. R. Parker, University of California, and R. Smoluchowski, General Electric Co.
- The Effect of Fiber on Notched Bar Tensile Strength Properties of a Heat Treated Low Alloy Steel**, by G. Sachs, J. D. Lubahn, L. J. Ebert and R. L. Aul, Case School of Applied Science.
- The Effects of Notches of Varying Depth on the Strength of Heat Treated Low Alloy Steels**, by G. Sachs, J. D. Lubahn and L. J. Ebert, Case School of Applied Science.

9:30 A. M.—Hardenability

- The Effect of Carbon Content on Hardenability**, by E. S. Rowland, J. Welchman, R. G. Hill and J. J. Russ, Timken Roller Bearing Co.
- Air-Hardenability of Steels**, by C. B. Post, M. C. Fetzer and W. H. Fenstermacher, Carpenter Steel Co.
- The Partition of Molybdenum in Steel and Its Relation to Hardenability**, by Fred E. Bowman, Climax Molybdenum Co.
- The Rate of Diffusion of Molybdenum in Austenite and in Ferrite**, by John L. Ham, Climax Molybdenum Co.

9:30 A. M.—Aluminum and Magnesium Alloys

- New Developments in High Strength Aluminum Alloy Products**, by E. H. Dix Jr., Aluminum Company of America.
- Aluminum Alloy Forging Materials and Design**, by L. W. Davis, Aluminum Company of America.
- The Properties of Aluminum Alloys Melted in an Induction Heated Crucible Furnace**, by James W. Poynter, Army Air Forces, Wright Field.
- Magnesium Sheet**, by P. T. Stroup and G. F. Sager, Aluminum Company of America, and J. B. West, American Magnesium Corp.

11:30 A. M.—Victory Session Ballroom, Hotel Statler

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with No. 05 Auxiliary Lens.



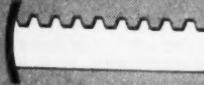
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STANLEY

TRADE MARK



WEDNESDAY, OCTOBER 18

7:30 A. M.—Chapter Chairmen's Breakfast

9:30 A. M.—Annual Meeting of the American Society for Metals
Ballroom, Hotel Statler

Edward de Mille Campbell Memorial Lecture, by G. R. Fitterer, Professor and Head, Department of Metallurgical Engineering, University of Pittsburgh

12:00 M.—Canadian Luncheon

THURSDAY, OCTOBER 19

9:30 A. M.—Melting and Special Alloys

A Comparison of Aluminum and Titanium Deoxidation for Preventing Strain Aging Embrittlement in Low Carbon Steel, by G. F. Comstock and J. B. Lewis, Titanium Alloy Manufacturing Co.

The Ar' Reaction in Some Iron-Cobalt Tungsten Alloys and the Same Modified With Chromium, by W. P. Sykes, General Electric Co.

The Basic Electric Melting Procedure for High Quality Alloy Steels, by A. Ascik, Sorel Industries, Limited.

9:30 A. M.—Tool Steel

The Dimensional Stability of Steel—Part I—Sub-atmospheric Transformation of Retained Austenite, by S. G. Fletcher and Morris Cohen, Massachusetts Institute of Technology.

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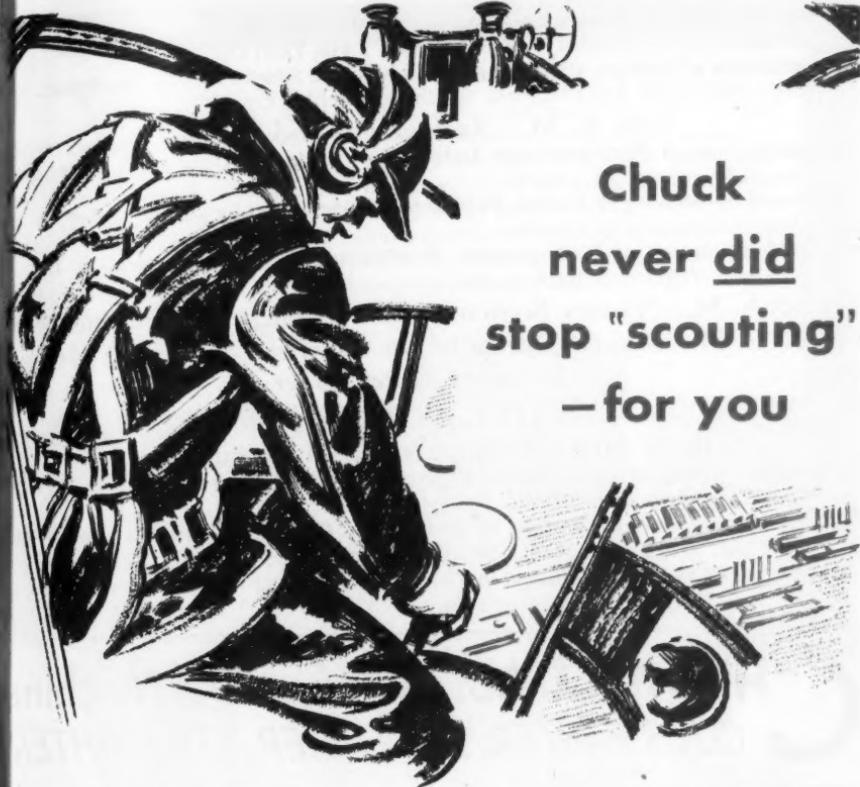
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A Study of Subzero Treatments Applied to Molybdenum-Tungsten High Speed Steel, by R. G. Kennedy, Jr., Cleveland Twist Drill Co.

Experiments of Sodium Cyaniding of High Speed Steel Prior to Hardening,
John McIntyre, International Business Machine Co.

9:30 A. M.—Radiography and Testing

A Comparison of Microhardness Indentation Tests, by Douglas R. Tate, National Bureau of Standards.

Improved Sensitivity in Double Exposure Radiography, by James Rigbey, Ford Motor Company of Canada.

The Interpretation of Radiographs: Particularly of Aircraft Parts, by Leo W. Ball, Triplett & Barton, Inc.

11:30 A. M.—Victory Session; 12 M.—College Alumni Luncheon

**7:00 P. M.—Annual Dinner of the American Society for Metals
Ballroom, Hotel Statler**

FRIDAY, OCTOBER 20

9:30 A. M.—Chromium and Molybdenum Alloys

Chromium Steels of Low Carbon Content, by Russell Franks, Union Carbide and Carbon Research Labs.

Characteristics and Properties of Some Cast Chromium-Molybdenum Steels,
by N. A. Ziegler and W. L. Meinhart, Crane Co.

The Segregation of Molybdenum in Phosphorus Bearing Alloyed Gray Cast Iron,
by F. B. Rote, Wyman-Gordon Co. and W. P. Wood, University of Michigan

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A. S. M. Group Discussion Meetings

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Monday, Oct. 16	Tuesday, Oct. 17	Wednesday, Oct. 18	Thursday, Oct. 19	Friday, Oct. 20
2:00 P. M.	2:00 P. M.	2:00 P. M.	2:00 P. M.	2:00 P. M.
Metal Cutting and Tool Materials	The Hardenability Band as a Basis for Purchase and Use of Steel	Metals for Railroads	Salt Baths	Heat Treatment
2:00 P. M.	2:00 P. M.	Metallurgical Furnaces	2:00 P. M.	2:00 P. M.
Light Weight Construction	Magnesium	Products From Metal Powders	Aluminum	Foundry Metallurgy
4:00 P. M.	Instruments for Quality Control	4:00 P. M.	4:00 P. M.	4:00 P. M.
Sub-Zero Treatments	A—Measurements of Linear Dimensions	Instruments for Quality Control	Quality Control by Statistical Methods	Instruments for Quality Control
4:00 P. M.	Surface Finishes and Protection	4:00 P. M.	B—Means to Establish Identity	Nationally known experts in the fields encompassed by these meetings will give brief talks on the various subdivisions of each topic. These men will then act as an information panel for open discussion and questions from the audience. Complete program, including subdivisions and names of panel members, will be circulated to those attending the National Metal Con-
8:30 P. M.	Induction Heating	8:30 P. M.	8:30 P. M.	8:30 P. M.
8:30 P. M.	What's New in the Study of Corrosion	8:30 P. M.	Tin; Tin Alloys; Tin Coatings	Manufacture of Quality Steels

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Tin Coatings

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A. I. M. E. Metals Divisions
MONDAY, OCTOBER 16
10:30 A. M.—Euclid Room, Hotel Statler

Magnesium

The Relationship Between Magnesium Core Sand Mixtures and the Burning of Magnesium, by O. J. Myers, Wright Aeronautical Co.
Solubility of Manganese in Magnesium, by N. Tiner, Permanente Metals Co.

2:00 P. M.—Euclid Room, Hotel Statler

Grain Size of Magnesium

Grain Size and Properties of Sand Cast Magnesium, by R. S. Busk and C. W. Phillips, Dow Chemical Co.

Factors Affecting Grain Growth in Germination of Magnesium Alloy Casting, by A. T. Peters, R. S. Busk, and H. E. Elliott, Dow Chemical Co.

Grain Size of Sand Cast Magnesium Alloys, by Oscar Blohm, Hills-McCanna Co.

TUESDAY, OCTOBER 17

9:30 A. M. and 2:00 P. M.—Euclid Room, Hotel Statler

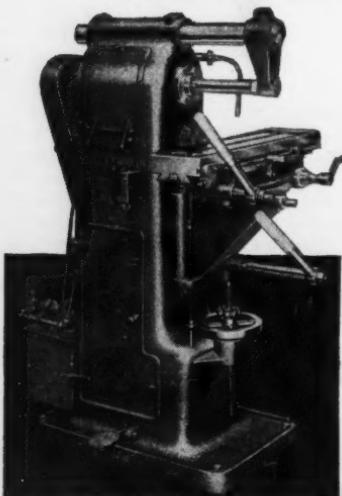
Symposium on Creep of Non-Ferrous Metals and Alloys

Chairman—M. L. Gurghoff and E. E. Schumacher.

Application of Non-Ferrous Alloys in Stress Design, by J. J. Kanter, Crane Co.
Creep Test Methods and the Interpretation of Creep Data, by P. G. McVeety

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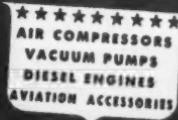
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Creep Characteristics of a Phosphorized Copper, by N. L. Burghoff and A. I. Blank, Chase Brass and Copper Co.

Creep Properties of Cold Drawn Annealed "B" Monel and Inconel, by B. E. Betty, H. L. Eiselstein and P. P. Huston, Jr., International Nickel Co.

Creep Properties of Cast Bronze, by H. E. Montgomery, The Lunkenheimer Co.

Creep Data on Die Cast Zinc Alloy, by E. H. Kelton and B. B. Grissinger, New Jersey Zinc Co.

Creep Properties of Some Rolled Lead Alloys, by A. A. Smith, Jr., American Smelting and Refining Co.

2:00 P. M.—Lattice Room, Hotel Statler

Non-Ferrous Production Metallurgy

Tin Smelting and Metallurgy, by C. L. Mantell, Consulting Chemical Engineer.

Beryllium, by Donald M. Liddell, Consulting Engineer.

Antimony: Its Metallurgy and Refining, by Chung Yu Wang, Wah Chang Trading Corp., and Guy C. Riddell, Consulting Mining Engineer.

WEDNESDAY, OCTOBER 18

2:00 P. M.—Pine Room, Hotel Statler

General Session

Orientation Structure on the Surface of Cast Metals, by Gerald Edmunds, New Jersey Zinc Co.

NEBEL Geared Head Lathes

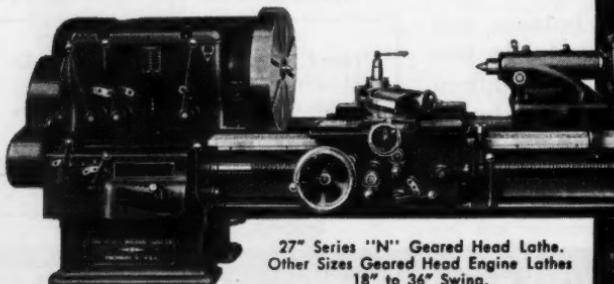
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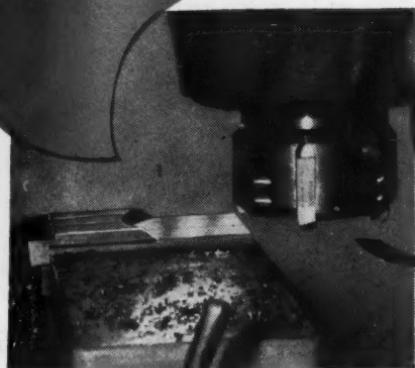


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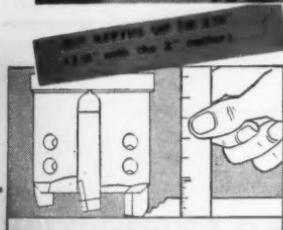
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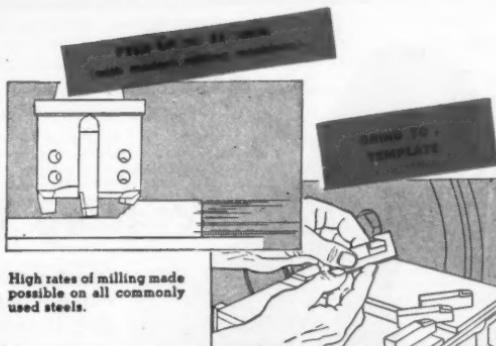


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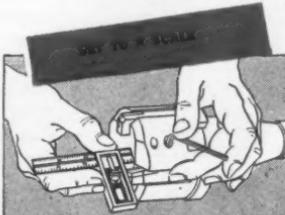
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The Hardness of Silver-Antimony Solid Solutions, by R. M. Treco and J. H. Frye, Lehigh University.

Substitute Solders on the 85-15 Lead-Tin Type, by James B. Russell, and J. O. Mack, Naval Research Laboratory.

IRON AND STEEL DIVISION
MONDAY, OCTOBER 16
2:00 P. M.—Pine Room, Hotel Statler
General Session

Recovery of Cold Worked Aluminum-Iron as Detected by Changes in Magnetic Properties, by J. S. Stanley, Westinghouse Electric and Mfg. Co.

Distribution of Carbon Between Titanium and Iron in Steels, by W. P. Field and Bryson Robertson, Vanderbilt University.

Transformation of Austenite in a 3% Chromium 1% Carbon Steel, by E. P. Klier, Pennsylvania State College.

TUESDAY, OCTOBER 17
10:00 A. M.—Pine Room, Hotel Statler

General Session

Measurement and Control of Hydrogen Embrittlement in Type 440C Stainless Steel Wire, by C. A. Zapffe and M. Eleanor Haslein, Rustless Iron and Steel Corp.

Effect of Time Storage on Ductility of Welded Test Specimens, by C. E. Jackson and G. G. Luther, Naval Research Laboratory.



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2:00 P. M.—Pine Room, Hotel Statler

Symposium on Recent Developments in Dilatometric Analysis

Chairmen—F. M. Walters, Jr., and Howard Scott.

Dilatometric Analysis of Sub-atmospheric Transformations, by R. D. Potter, Massachusetts Institute of Technology.

A High-speed Dilatometer and the Transformational Behavior of Six Steels, by A. L. Christiansen, E. C. Nelson, and C. E. Jackson, Naval Research Laboratory.

Precise Expansion Measurements on Non-Ferrous Alloys and Glasses, by W. E. Kingston, Sylvania Electric Products, Inc.

An Interference Type Dilatometer and Some Typical Results, by W. L. Fink and L. A. Willey, Aluminum Co. of America.

WEDNESDAY, OCTOBER 18

2:00 P. M.—Euclid Room, Hotel Statler

Symposium on Steelmaking

Chairmen—L. F. Reinartz and H. K. Work.

Theoretical and Practical Aspects of Deoxidation in Basic Open Hearth Practice, by T. S. Washburn, Inland Steel Co.

Slag-Metal-Oxygen Relationships in the Basic Open Hearth and Electric Processes, by J. S. Marsh, Bethlehem Steel Co.

A Rapid Laboratory Method for Estimating Basicity of Open-Hearth Slag, by W. O. Philbrook, A. J. Jolly, Jr., and T. R. Henry, Wisconsin Steel Works.

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ABERDEEN SOUTH DAKOTA

Application of pH Slag Basicity Measurements to Basic Open-Hearth Phosphorus Control, by Michael Tenenbaum and C. C. Brown, Inland Steel Co.

9:30 A. M.—Fracture and Grain Size

Fractography—A New Tool for Metallurgical Research, by Carl A. Zapffe and Mason Clegg, Jr., Rustless Iron and Steel Corp.

Cleavage Structures of Iron-Silicon Alloys, by Carl A. Zapffe and Mason Clegg, Jr., Rustless Iron and Steel Corp.

Grain Shape and Grain Growth, by David Harker, General Electric Co., and Earl R. Parker, University of California.

Fracture Studies of Soldered Joints, by F. Berman and R. H. Harrington, General Electric Co.

9:30 A. M.—Rolling and Graphitization

Annealing Studies on Cold-Rolled Iron and Iron Binary Alloys, by C. R. Austin, L. A. Luini and R. W. Lindsay, Pennsylvania State College.

The Effect of Cold Rolling on the Structure of Hadfield Manganese Steel, by Norman P. Goss, Cold Metal Products Co.

Factors Controlling Graphitization of Carbon Steels at Subcritical Temperatures, by C. R. Austin, Pennsylvania State College, and M. C. Fetzer, Carpenter Steel Co.

11:30 A. M.—Victory Session

Ballroom, Hotel Statler

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TUESDAY, OCTOBER 17

10:00 A. M.—*Grand Ballroom, Hotel Carter*

Words of Welcome by President W. M. Murray
Technical Session

Chairman—C. O. Dohrenwend, Armour Research Foundation.

Shot Peening to Improve Fatigue Resistance, by O. J. Horger and H. R. Neifert,
The Timken Roller Bearing Co.

Plastic-Flow Problems by Photo-Grid Methods, by J. F. Harding and C. P.
O'Haven, Armour Research Foundation.

Load Distribution in Riveted and Spot-Welded Joints, by M. Goland and L. D.
Morris, Curtiss-Wright Corp.

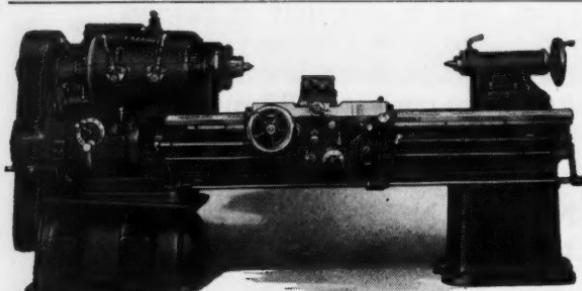
2:30 P. M.—*Grand Ballroom, Hotel Carter*

Technical Session

Chairman—O. J. Horger, The Timken Roller Bearing Co.

Residual Stress Studies of Life Improving Surface Treatments, by R. W.
Greaves, E. C. Kirstowsky and C. Lipson, Chrysler Corp.

New Approaches to Engineering Design, by E. E. Stilson, R. H. Peterson and
R. C. Pocock, Bendix Aviation Corp.



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WEDNESDAY, OCTOBER 18
10:00 A. M.—Grand Ballroom, Hotel Carter
Symposium on Crankshaft Stresses

Chairman—C. Lipson, Chrysler Corp.

Structural Evolution of a Crankshaft, by S. Oldberg and C. Lipson, Chrysler Corp.

Determination of Operating Loads and Stresses in Crankshafts, by A. Golof, Caterpillar Tractor Co.

Metallurgical Processing of Packard Built Rolls-Royce Crankshafts, by M. L. Frey, Packard Motor Car Co.

2:30 P. M.—Grand Ballroom, Hotel Carter
Technical Session

Chairman—J. M. Lessells, Massachusetts Institute of Technology.

Full Scale Fatigue Testing of Crankshafts, by C. W. Gadd and N. A. Ochiltree, General Motors Research Laboratories.

Determining Crankshaft Durability for Increased Performance of In-Line Engine, by W. Osborn, Sterling Engine Co.

THURSDAY, OCTOBER 19
10:00 A. M.—Grand Ballroom, Hotel Carter
Technical Session

Chairman—C. W. MacGregor, Massachusetts Institute of Technology.

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The Application of Stress Models to Specific Structural Problems, by S. F. Tingley, Goodyear Aircraft Corp.

Electrical Analogy for Shear Lag Problems, by R. E. Newton, Curtiss Wright Corp.

Electric Method for the Solution of Laplace's Equation, by V. Paschkis, Columbia University.

6:30 P. M.—S.E.S.A. Dinner, Grand Ballroom, Hotel Carter

FRIDAY, OCTOBER 20

10:00 A. M.—Grand Ballroom, Hotel Carter

Technical Session

Chairman—E. L. Shaw, Goodyear Aircraft Corp.

Precision Determination of Weight by Means of Bonded Strain Gages, by A. L. Thurston, Cox & Stevens Aircraft Corp., and R. W. Cushman, The Foxboro Co.

The Magnetic Coupled-Torque Meter, by B. F. Langer, Westinghouse Research Laboratories.

Impact Stress Analysis by Brittle Coatings, by G. Ellis, Magnaflux Corp.

2:30 P. M.—Grand Ballroom, Hotel Carter

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who dares to talk to them about a

THIRD WORLD WAR?

They were at Tarawa.

Many of them now wear empty sleeves, or bandages where their eyes were. And a thousand and twenty-six will rise up never from the sands of Tarawa Island.

They couldn't hear it. In the roar of that tornado, as they fought and fell, so far from the hills of home, they couldn't hear the words: " . . . history repeats . . . and what will we get out of it but . . . how the hell can we police . . . the next one will be against . . . already sowing the seeds for . . . and twenty years from now, brother . . . the Third World War . . ."

In elevators, on the street, in plush chairs that let you down easy, in columns and editorials and from the political stump.

What is the matter with us? Can't we at home at least go into peace with some spark of their courage and determination that this war is not another mockery, not just another World War? Let no man give voice to that weak and deadly cynicism. Let him stand up and think straight and have the courage to call the lie to any man in public or private life who fails to do the same.

And let each of us do everything humanly possible to help win this war sooner . . . buy War Bonds—give blood—boycott the black market . . . and plan ahead now for a better America than we had before.

Today, the engineers of the machine tool industry can greatly help the post-war planners of government and business management. One of these is a Bryant man . . .

We invite you to send for him.



BRYANT CHUCKING GRINDER COMPANY

SPRINGFIELD, VERMONT, U. S. A.

Chairman—G. S. Burr, Forging Research Association.
Electric Gaging Systems: Their Selection and Application, by H. C. Robert,
University of Illinois.
Open Forum for Discussion on Characteristics of Amplifiers, Characteristics of
Galvanometers, Calibration Circuits, Methods of Recording, Use of Crystals
in Stress Analysis, and Additional Topics Put Forward by the Audience.

American Welding Society

Twenty-Fifth Annual Meeting, Hotel Cleveland, October 16-19

MONDAY, OCTOBER 16

9:30 A. M.—Opening Session

Chairman—David Arnott, President, American Welding Society.

Vice-Chairman—E. V. David, Chairman, Convention Committee.
Presentation of Medals and Prizes.

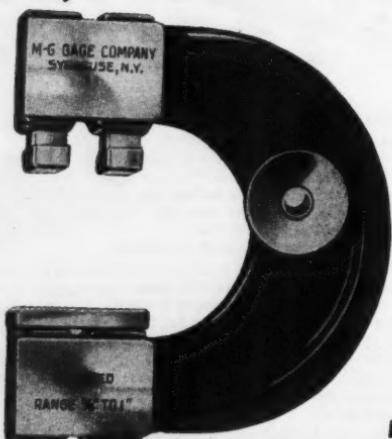
Welding Aids the War Effort

Welding as an Aid in Shipbuilding Construction, by Admiral H. L. Vickery,
U. S. Maritime Commission.

Welding as an Aid in the Fabrication of Ordnance Equipment, by Col. S. B.
Ritchie, Office, Chief of Ordnance.

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Welding in Aircraft Construction, by W. B. Stout, Consolidated Vultee Aircraft Corporation.

2:00 P. M.—Welding and Cutting in Heavy Industries

Chairman—R. J. Yarrow, Republic Structural Iron Works.

Vice-Chairman—J. M. Driscoll, Air Reduction Sales Co.

Fundamentals of Heavy Cutting, by G. L. Walker and H. G. Hughey, Air Reduction Sales Co.

Steel Mill Maintenance, by E. W. Gruber, Wheeling Steel Corp.

Unusual Applications of Gas Cutting in Ordnance Fabrication, by C. M. Underwood, Northern Ordnance, Inc.

Procedure Control of Automatic Welding Processes, by A. E. Bedell and J. B. Quigley, Graver Tank & Mfg. Co., Inc.

2:00 P. M.—Railroad and Transportation

Chairman—J. W. Sheffer, American Car and Foundry Co.

Vice-Chairman—A. G. Oehler, Railway Age.

Welding of Aluminum Tank Cars, by A. H. Woollen, Railroad Sales, Aluminum Co. of America.

Railroad Welding, by John McMullen, Erie R. R.

2:00 P. M.—Weldability

Chairman—A. B. Kinzel, Union Carbide & Carbon Corp.



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DETROIT 21, MICH.

- Vice-Chairman—C. H. Jennings, Westinghouse Electric & Mfg. Co.
Welding of Manganese Steels, by W. B. Brooks and A. G. Waggoner, Cramp
Shipbuilding Co.
High Tensile Manganese-Silicon Steels for Welded Fabrication, by G. G. Luther
and F. H. Laxar, Naval Research Lab.
The Bead-Weld Nick-Bend Test for Ductility, by C. E. Jackson and G. G.
Luther, Naval Research Lab.
The Influence of Minor Variables of Weldability, by R. D. Stout, S. S. Tor and
G. E. Doan, Lehigh University.

8:00 P. M.—Adams' Lecture

Chairman—Wendell F. Hess, Rensselaer Polytechnic Institute.

Vice-Chairman—R. H. Aborn, United States Steel Corp.

Solid Phase Welding, by A. B. Kinzel, Union Carbide & Carbon Corp.

TUESDAY, OCTOBER 17

9:30 A. M.—Resistance Welding

Chairman—L. C. Bibber, Carnegie-Illinois Steel Corp.

Vice-Chairman—G. N. Sieger, S. M. S. Corp.

Spot Welding Machines for Heavy Gauges of Ferrous and Non-Ferrous Metals,
by Mario Sciaky, Sciaky Bros.

Heat Transfer Across Contact Surfaces, by W. B. Kouwenhoven, Dean, School
of Engineering, Johns Hopkins University.

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Problems in Spot Welding Heavy Mild Steel Plate, by F. R. Hensel, E. I. Larson
and E. F. Holt, P. R. Mallory & Co., Inc.

9:30 A. M.—Research

Chairman—S. L. Hoyt, Battelle Memorial Institute.

Vice-Chairman—R. E. Kinkead, Consulting Welding Engineer.

The Effect of Postheating in Welding Medium Alloy Steels, by M. A. Pugay
and G. J. Siegel, Naval Research Laboratory.

Stress Relieving Study, by Prof. J. R. Stitt, Ohio State University.

The Effects of Metallurgical Changes Due to Heat Treatment Upon the Fatigue

Strength of Carbon-Steel Plates, by W. H. Bruckner, and W. H. Munz,
University of Illinois.

9:30 A. M.—Structural

Chairman—A. S. Low, The Austin Co.

Vice-Chairman—J. F. Maine, Republic Structural Iron Works.

Standard Details for Welded Building Construction, by H. W. Lawson, Bethlehem Steel Co.

Field Welded Pressure and Variable Volume Storage Tanks, by Fred L. Plummer, Hammond Iron Works.

2:00 P. M.—Resistance Welding

Chairman—R. E. Powell, Western Electric Co.

Vice-Chairman—H. C. Cogan, National Electric Welding Machines Co.



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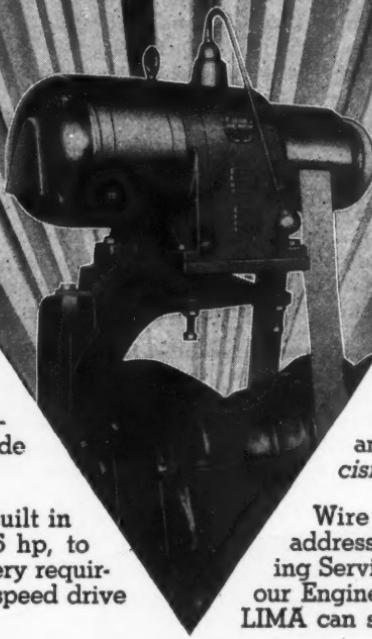
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Low Reactance Cable for Portable Resistance Welders, by Myron Zucker, Mackworth G. Rees, Inc.

The Flash Welding of Alloy Steels—Welding Techniques and Variables, by J. J. Riley; **Metallurgical and Physical Characteristics**, by J. C. Barrett, Taylor-Winfield Corp.

Small Portable Condenser Welding Set, by E. M. Callender, E. G. Budd Mfg. Co.

2:00 P. M.—Research

Chairman—H. C. Boardman, Chicago Bridge & Iron Co.

Vice-Chairman—G. V. Slottman, Air Reduction Sales Co.

Some Recent Developments in Stainless Steel Welding, by D. L. Mathias, Metal & Thermit Corp.

Bi-axial Fatigue Strength of Low-Carbon Steels, by George K. Morikawa and LeVan Griffis, Illinois Institute of Technology.

Intergranular Corrosion of Stainless Steel Welds, by Wm. T. Tiffin, University of Oklahoma.

Weldability Tests of Cast Steel, by C. E. Jackson and F. S. McKenna, National Research Lab.

2:00 P. M.—Ships

Chairman—J. L. Wilson, American Bureau of Shipping.

Vice-Chairman—S. A. Midnight, American Shipbuilding Co.

Controls Required for Safe and Economical Construction of Welded Ships,

D. G. Maxson, Welding Consultant, Marinship Corp.



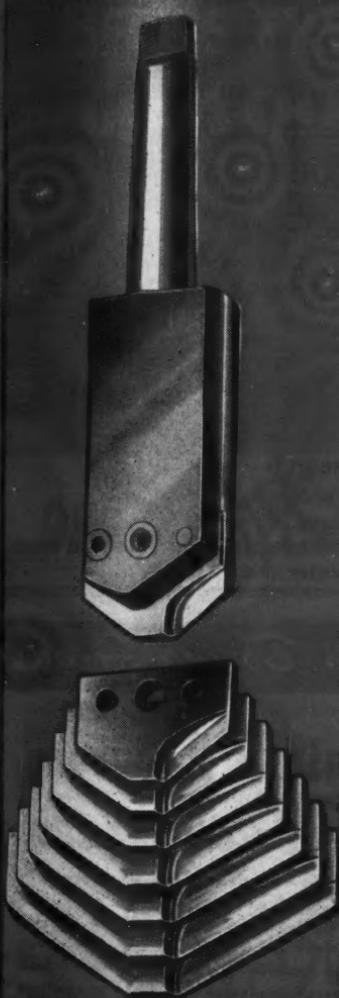
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Technical Control of Welding in Ship Construction, by M. H. MacKusick, California Shipbuilding Corp.

Evolution of Welding in Shipbuilding, by M. N. Maltseff, Western Pipe and Steel Co.

Multiple and Stack Machine Cutting, by A. H. Yoch, Air Reduction Sales Co.

8:00 P. M.—University Research Conference

WEDNESDAY, OCTOBER 18

9:30 A. M.—Aircraft

Chairman—G. S. Mikhalapov, National Research Council.

Vice-Chairman—C. W. Dodge, Sciaky Bros.

Impact Strength of Arc Welded Joints in Aircraft Steel, by H. O. Klinke, Republic Aviation Corp.

Helium Shielded Arc Welding of Exhaust Collector Rings, by Francis R. Stevenson, Lockheed Aircraft Corp.

Multi-Arc Welding of Aluminum Alloys, by M. R. Rivenburgh and C. W. Standard, Curtiss-Wright Corp.

9:30 A. M.—Research

Chairman—Isaac Harter, The Babcock & Wilcox Co.

Vice-Chairman—E. R. Seabloom, Crane Co.

Weldability—as-Rolled vs. Heat-Treated High Strength Constructional Steel
by Lt. S. A. Herres and W. L. Warner, Watertown Arsenal.

CRITERION Boring Heads

**Original Accuracy
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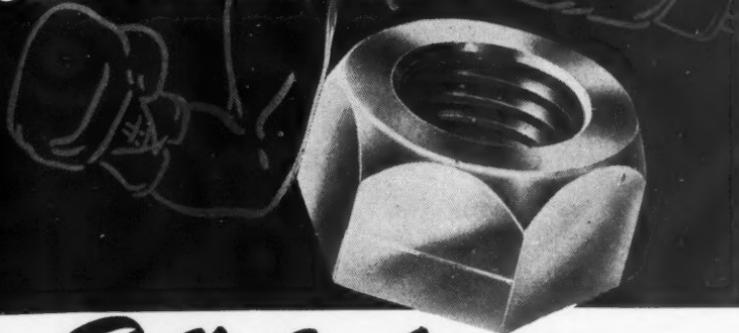
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ground from
solid AFTER
hardening.



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Detroit 2, Mich., General Motors Building

REPRESENTATIVES IN PRINCIPAL CITIES

The Effect of Time and Temperature on the Relief of Residual Stresses in Low Alloy Steels, by J. K. McDowell and Paul C. Cunnick, Lt. Col., Ordnance Dept., Rock Island Arsenal.

Development and Application of Modern Heavy Coated Arc Welding Electrodes, by D. C. Smith and W. G. Rinehart, Harnischfeger Corp.

2:00 P. M.—Aircraft

Chairman—G. O. Hoglund, Aluminum Co. of America.

Vice-Chairman—E. S. Jenkins, Curtiss-Wright Research Laboratory.
The Geometry of a Spot Welding Tip and Its Relation to Tip Life, by E. L. Crawford and C. W. Steward, Curtiss-Wright Corp.

Survey of Chemical Cleaning Practices for Spot Welding Aluminum Alloys, by F. M. Morris, Kaiser Cargo, Inc., Fleetwings Div.

An Evaluation of Process Control of Aircraft Welding, by P. H. Merriman, Glenn L. Martin Co.

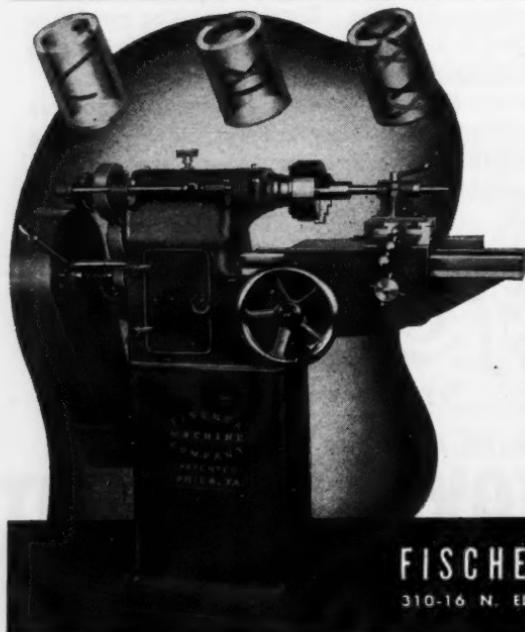
Characteristics of Welding Arcs on Aluminum in Atmospheres of Helium and Argon, by F. A. Wassell, General Electric Co.

2:00 P. M.—Machinery

Chairman—A. E. Gibson, Wellman Engineering Co.

Vice-Chairman—R. J. Kriz, The James H. Herron Co.
Production Problems and Production Control, by E. C. Brekelbaum, Harnischfeger Corp.

Routine Inspection and Salvage of Machinery Weldments—Rough, Part



FISCHER Oil Groovers

A wide variety of grooves may be cut on the "FISCHER" . . . with minimum set-up time and cost.

Bearing in which groove is to be cut is mounted on revolving cross secured on work spindle. Boiling tool is secured to carriage slide which has a reciprocating motion lined with work spindle and lined by crank gear and connecting rod.

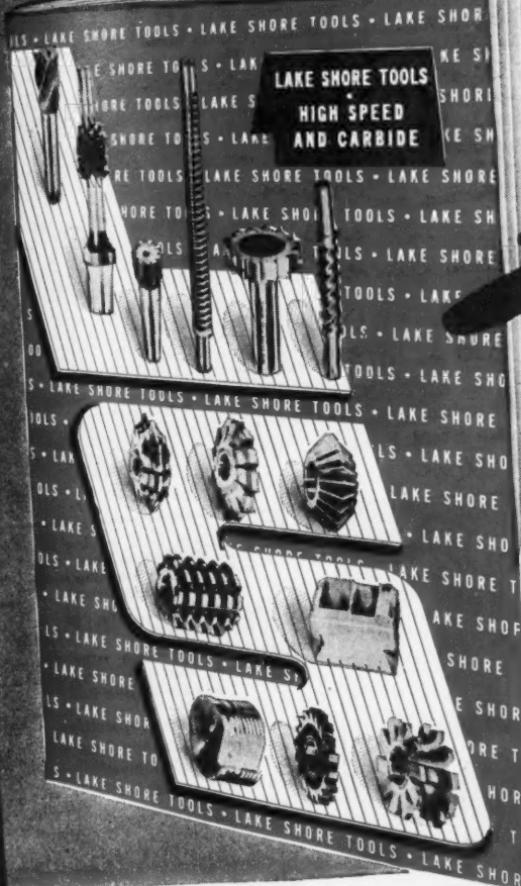
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October, 1944

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Welded Jigs and Fixtures, by A. N. Kugler, Air Reduction Sales Co.
Design of Welded Machinery, by John Mikulak, Electric Machinery Manufacturing Co.

2:00 P. M.—Piping and Pressure Vessels

Chairman—A. C. Weigel, Combustion Engineering Co.

Vice-Chairman—R. W. Emerson, Pittsburgh Piping & Equipment Co.
Pressure Vessel Welding, by Edward B. McGuire, Hamler Boiler & Tank Co.
Normalizing of Welds in Carbon-Molybdenum Pipe by 60-Cycle Induction Heating, by I. A. Rohrig and D. H. Corey, The Detroit Edison Co.

Properties of Welded Joints Between Dissimilar Metals, by E. C. Chapman and R. E. Lorentz, Combustion Engineering Co.
Oxy-Acetylene Pressure Welding, by A. R. Lytle, Union Carbide & Carbon Res. Labs.

6:30 P. M.—Section Officers Dinner and Conference

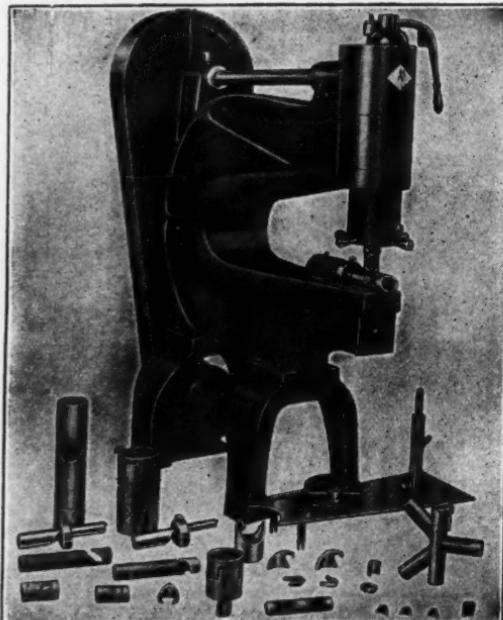
THURSDAY, OCTOBER 19

9:30 A. M.—Foundry

Chairman—L. A. Danse, Cadillac Motor Car Div.

Vice-Chairman—Austen J. Smith, The Lunkenstein Co.

Arc Welding Practices in the Steel Foundry, by Frank Kiper and Lawrence Gabes, Ohio Steel Foundry.



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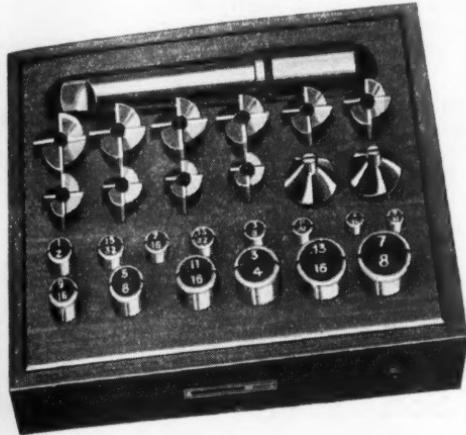
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11/16" "	1/4" "
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15/16" "	1/4" "
1" "	5/16" "
13/16" "	1 1/4" "
9/16" "	5/16" "
COUNTERBORES	
5/16" Dia.	3/8" Dia.
5/8" "	13/16" "
11/16" "	1" "
7/8" "	1 1/8" "
15/16" "	1 1/4" "
COUNTERSINKS	
5/16" Dia.	60 Deg.
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5/16" Dia.,	1/4" Shank
5/8" "	1/4" "
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7/8" "	1/4" "
15/16" "	1/4" "
1" "	1/4" "

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Cutaway View Showing Features of Midwest Counterbore Assembly.

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Machine Cutting of Risers, Flame Scarfing to Remove Padding, and Flame Gouging to Remove Webs and Defects, by G. E. Bellew, Air Reduction Sales Co.

Repair of Castings, by L. A. Danse, Chairman, G. M. Metallurgical Committee, General Motors Corp.

9:30 A. M.—Miscellaneous

Chairman—W. E. Crawford, A. O. Smith Corp.

Vice-Chairman—A. L. Pfeil, Universal Power Corp.

Low Temperature Joining, by W. D. Wasserman and C. E. Swift, Eutectic Welding Alloys Co.

A Method for Measuring the Bond Strength of Sprayed Metal Coatings, by Kenneth Wilson, Metallizing Engineering Co.

How Much Ductility Is Necessary for Structure or Machine?, by W. J. Conley, Lincoln Electric Co.

2:00 P. M.—Business Meeting

3:00 P. M.—Board of Directors Meeting

American Industrial Radium and X-Ray Society, Inc.

Annual Convention, Hollenden Hotel, October 19 and 20

THURSDAY, OCTOBER 19

Morning—Technical Session

Three Technical Papers; Titles to Be Announced.

Afternoon—Annual Meeting and 1944 Mehl Lecture
Election of Officers.

Experimental Stress Analysis in Radiographically Sound Materials, by G. L. Clark, University of Illinois.

Address by Retiring President, Maynard B. Evans, Jr., Ternstedt Mfg. Division, General Motors Corp.

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Bronze Metal

Wayne Junction, Philadelphia, Pa.

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ARGUTO OILLESS BEARING CO.

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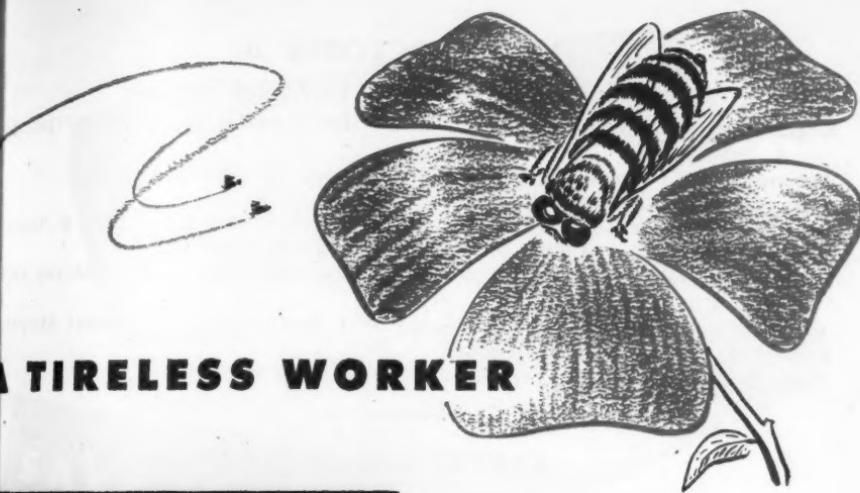
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FRIDAY, OCTOBER 20

Morning and Afternoon—Technical Sessions

Requirements in Specifications for Uniform Radiographic Technique, by George A. Russ.

Automatic Film Processing and Equipment, by Robert Sarderson.

X-Ray and Welding Control, by John J. Chyle.

Quality Control of Radiographs by a Direct Density Check, by Alvin F. Coe.

A Simplified Method of Film Evaluation, by Emery Meschter.

Method of Determining Metal Thickness Radiographically, by H. P. Moyer.

P. L. Kline.

A Practical Comparison of Fluoroscopy with Radiography, by Robert May.

Filtration, by Don M. McCutcheon.

Three Dimensional Radiography, by Douglas Wineck.

CLEVELAND SECTION

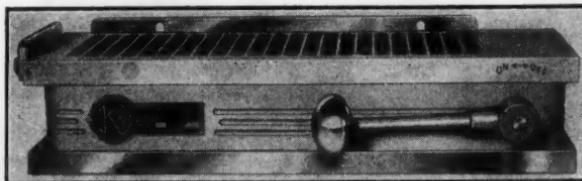
American Industrial Radium and X-Ray Society

Monday Evening, October 16

Hotel Hollenden

Use of Microradiography in Identifying Defects in Castings, by L. W. B.
Triplett & Barton Corp.

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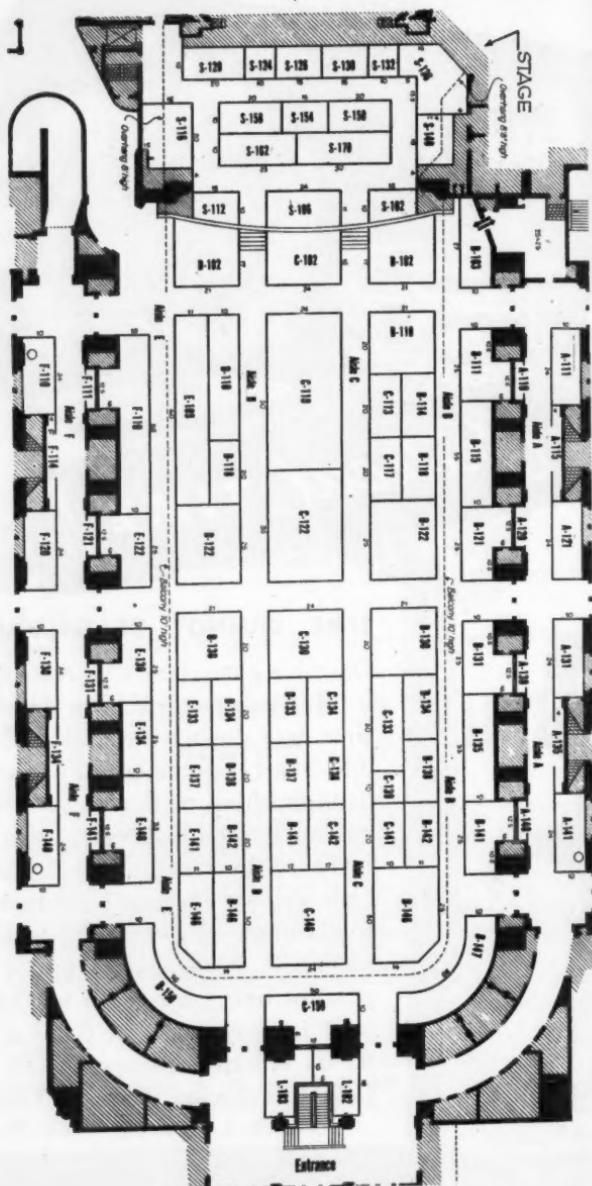
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October, 1944



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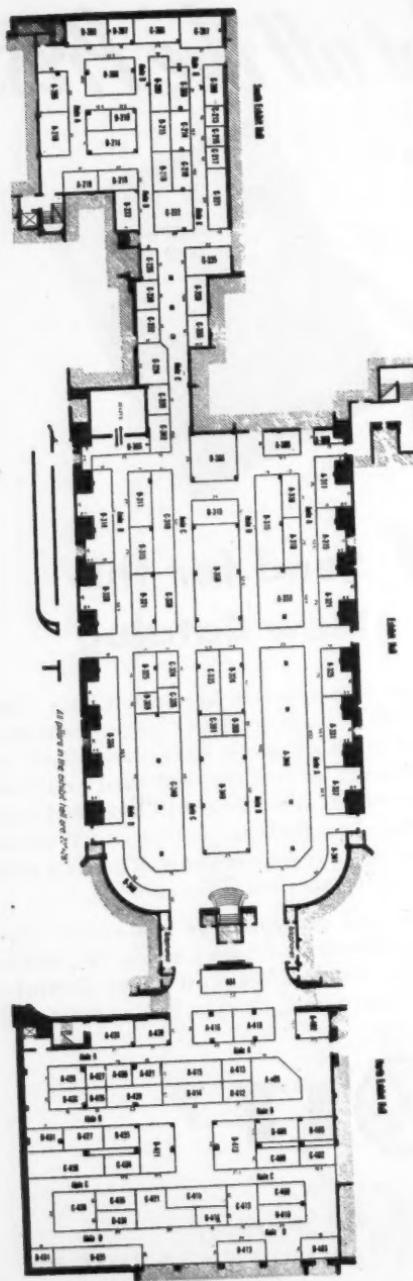
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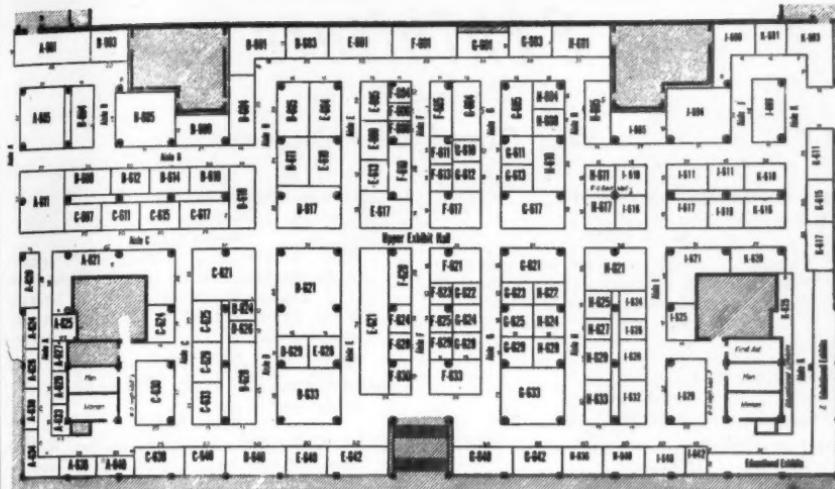
Showing

Arrangement of War Conference

Displays

**Cleveland Public
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UPPER EXHIBIT HALL



THE Cleveland Public Auditorium, in which the War Conference Displays are to be presented, is divided into five sections, as follows: the Arena, the Upper Exhibition Hall, Lower Exhibit Hall, Arcade, and Lakeside Exhibit Hall. The Arena, with which the stage is included, is on the street level. The other four exhibit halls are on the lower level, reached by stairs from the Arena.

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Booth D-315

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ALLOY RODS CO.

York, Pa.

Booth E-642

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P-516

Andrus, M

October, 1944



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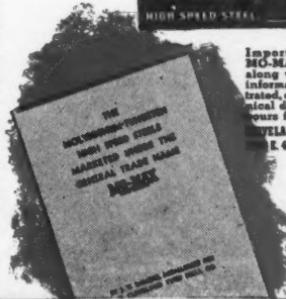
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"Bethlehem MM"	Bethlehem Steel Co., Inc.	"Di-Mol"	Henry Diaetone & Sons, Inc.	"Mo-Tung"	Universal Cyclops Steel Corp.
"Mo-Cu"	Brazos Alloy Steel Corp.	Rex-T-Mo"	Halcomb Steel Co.	"N-N"	Vulcanized Alloys Steel Co.
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(See Campbell Division, Andrew C.)

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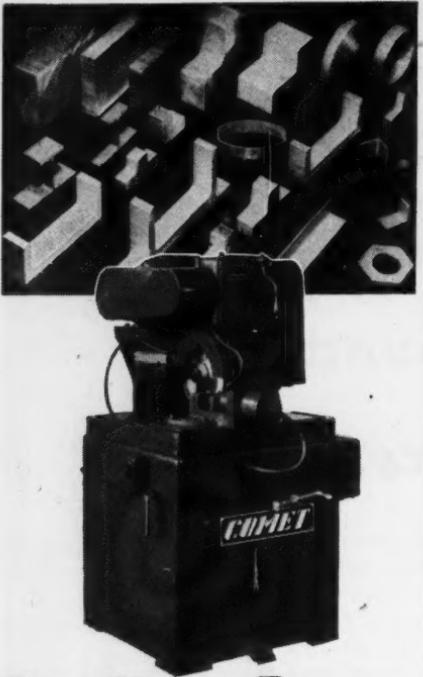
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Booth I-640

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Newark, N. J.

Booth A-421

Nicholas Schilling, in charge of furnace division.

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Chicago

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BAUSCH & LOMB OPTICAL COMPANY.

Rochester, N. Y.

Booth C-607

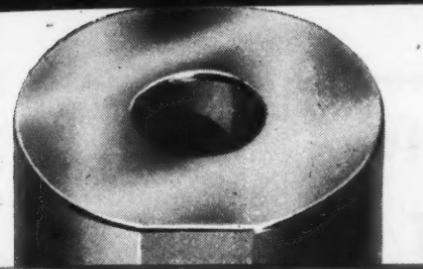
I. L. Nixon, sales manager, scientific instrument division; M. H. Stevens, assistant sales manager in charge of industrial sales; C. C. Nitchie, sales engineer; E. G. Koch, sales engineer; P. M. Stoehr, sales engineer; J. H. Mead, Chicago district sales engineer; L. B. McKinley, Cleveland-Pittsburgh district sales engineer; H. L. Shipp, Detroit district sales engineer.

BELL & GOSSETT CO.

Morton Grove, Ill.

Booth D-618

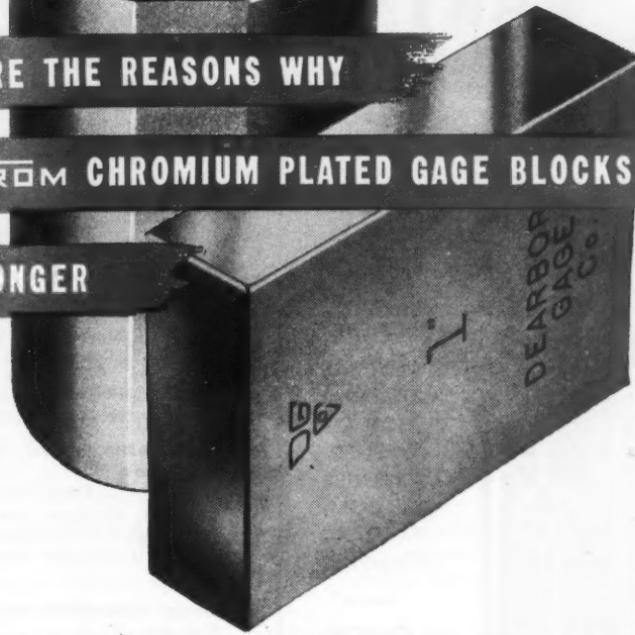
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This machine operates from your plant air line, and is one of numerous models built to produce fast, neat marking on metal parts. Hi-Duty marking machines may be had for practically any marking operation, and we will be glad to make recommendations upon receipt of your inquiries. Send prints or samples of parts to be marked, showing lettering and location, also state required production.

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Booth H-604

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Booth D-311

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 Milwaukee, Wis.

Booth C-625

Chas. H. Berenger, advertising manager; Arthur S. Fielding, Howard Weis and C. D. Herman, Cleveland representatives.

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Booth F-611

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 Bridgeport, Conn.

Booth A-315

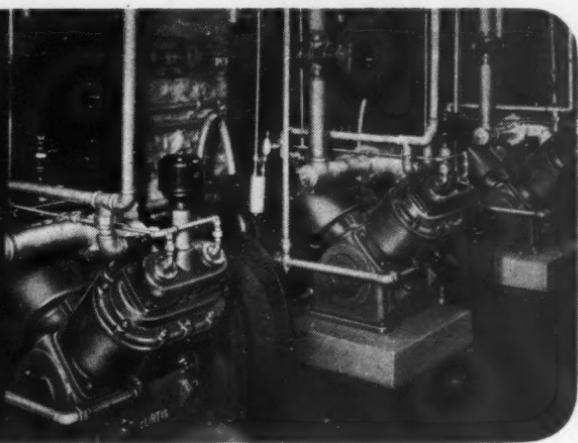
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 Cleveland

Booth D-640

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Burke motor driven milling machines Nos. 1, 2, 3, and 4 are specially suited for handling small, difficult work on a production basis.

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Detroit

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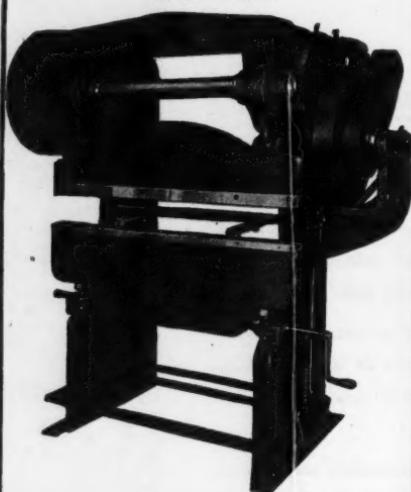
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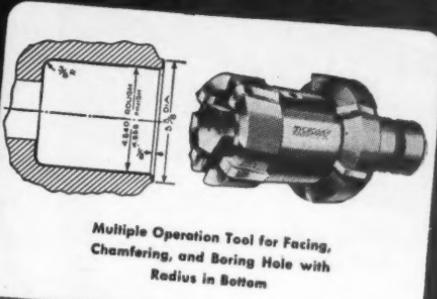
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Produces standard and special tools that
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Catalog 16-M describes
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Catalog 17 describes
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DI-ACRO precision bending is accurate to .001" for duplicated parts. DI-ACRO Benders bend angle, channel, steel, rod, tubing, wire, moulding, strip stock, etc. Machines are easily adjustable for simple, compound and reverse bends of varying radii.

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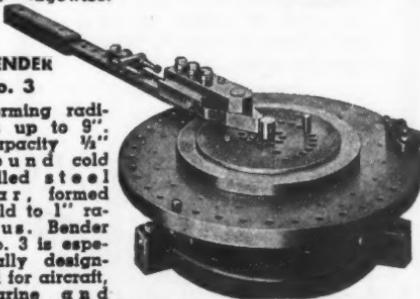
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October, October, 1944

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WITH WOMEN OPERATORS?



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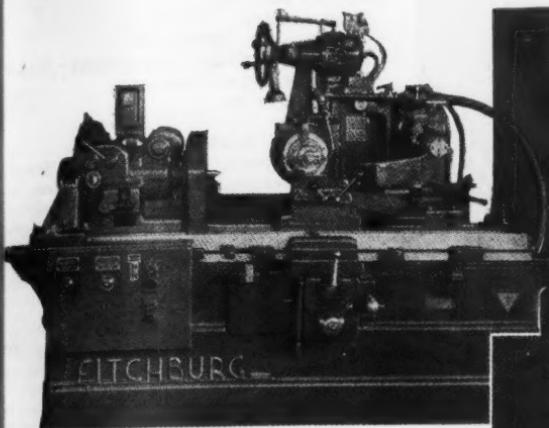
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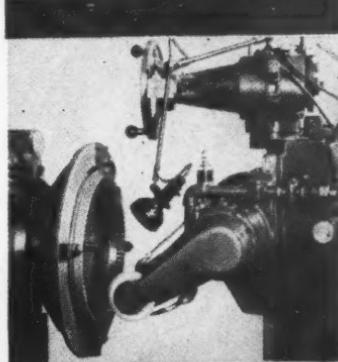
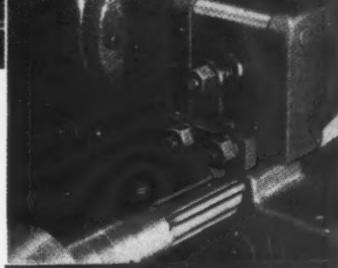
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— straight, taper and helical splines, and
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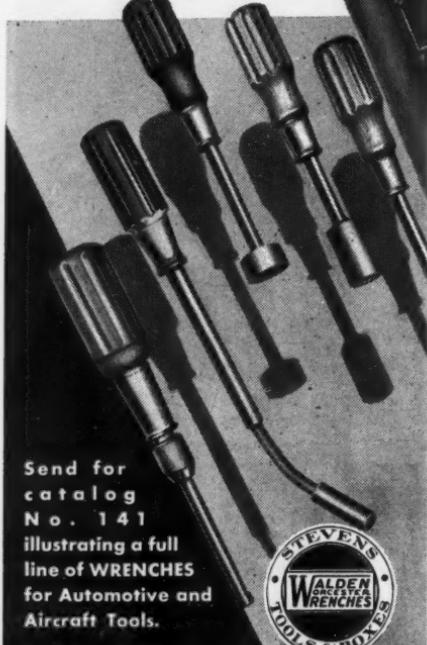
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Chicago

Booth A-624

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Booth F-633

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Cleveland

Booths B-320, B-314, C-315

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DOALL CO.

Des Plaines, Ill.

Booth C-315

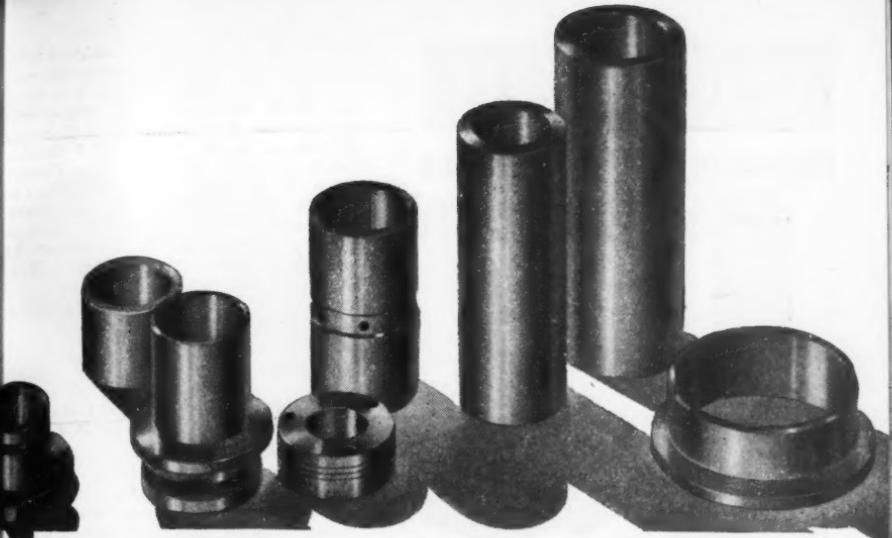
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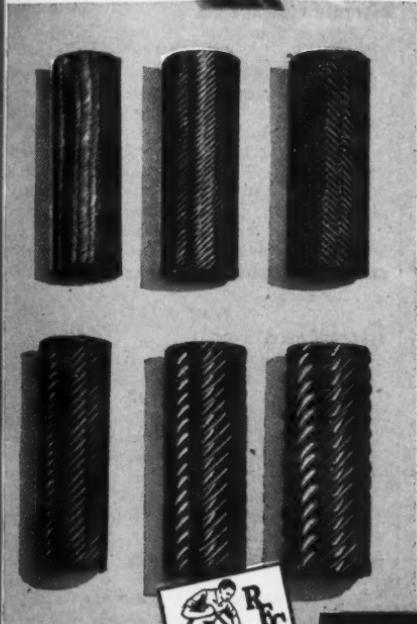
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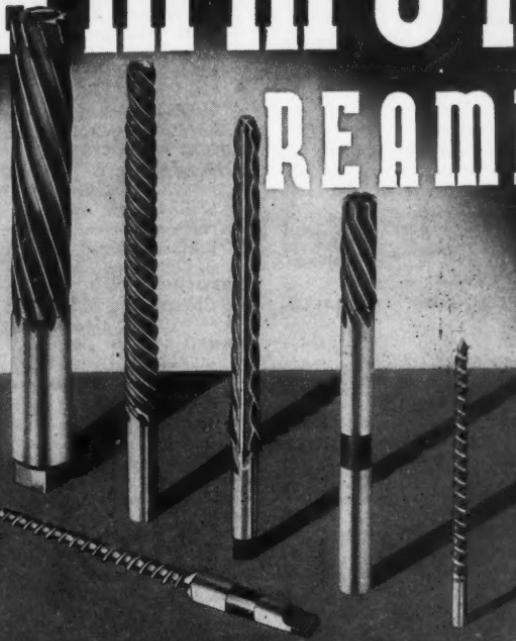
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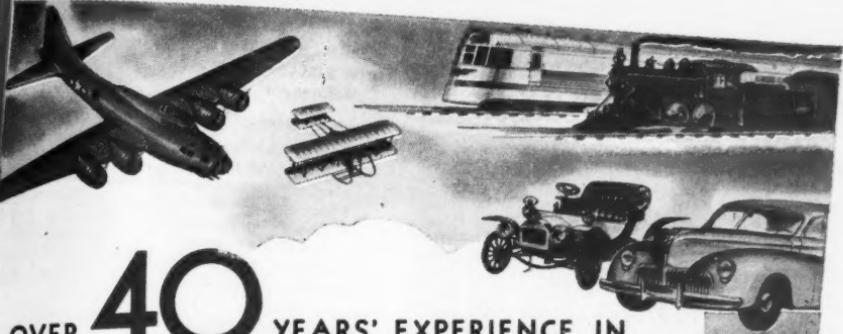
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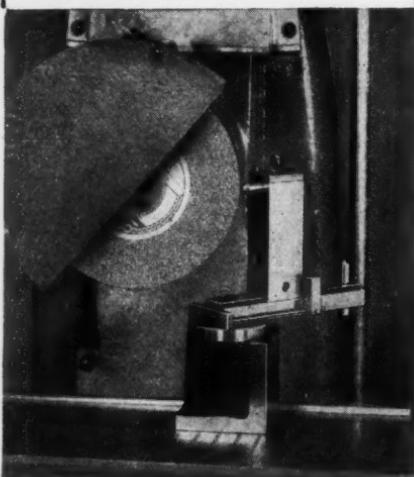
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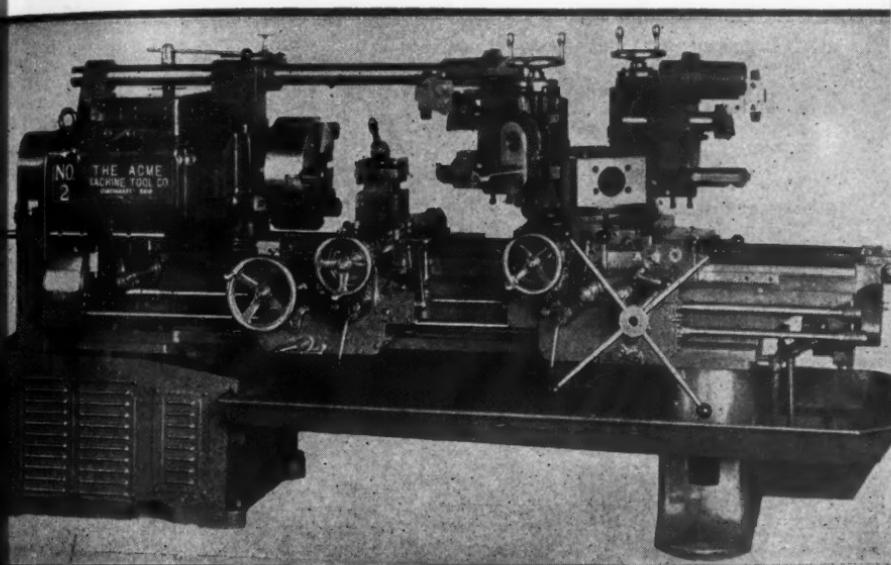
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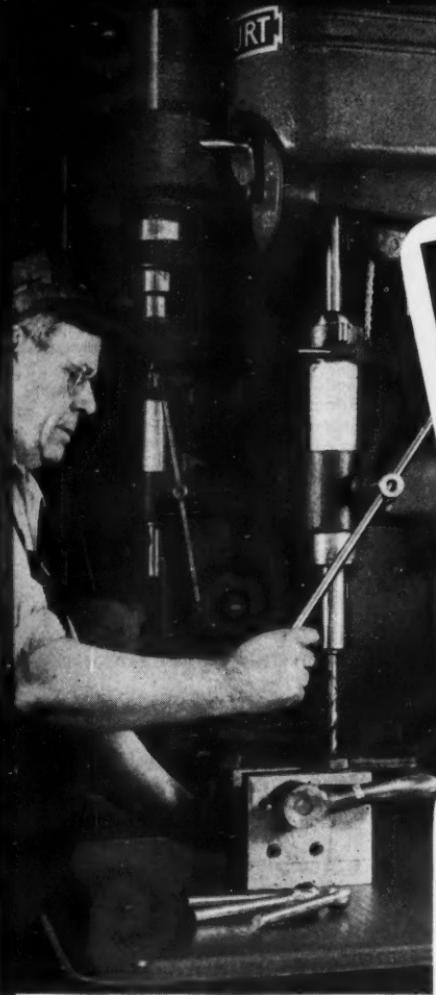
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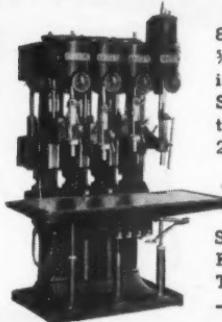
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(For Monarch Steel Co.)—F. T. Holliday, president; S. W. Terry, general sales man-

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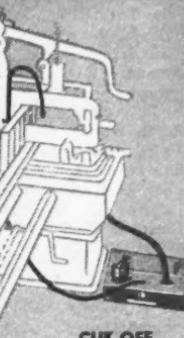
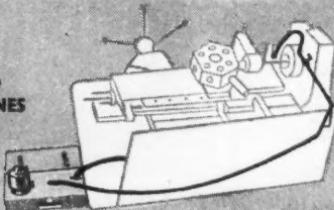
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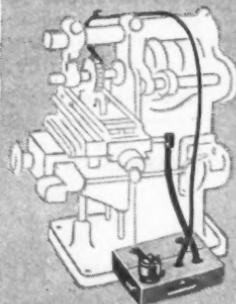
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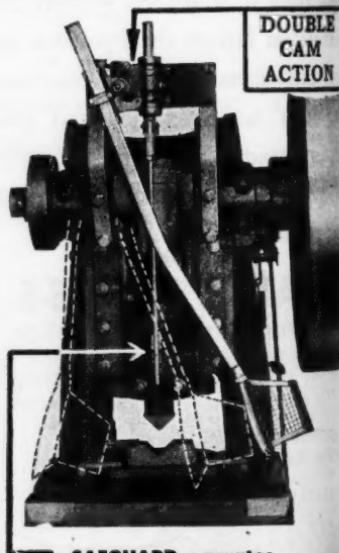
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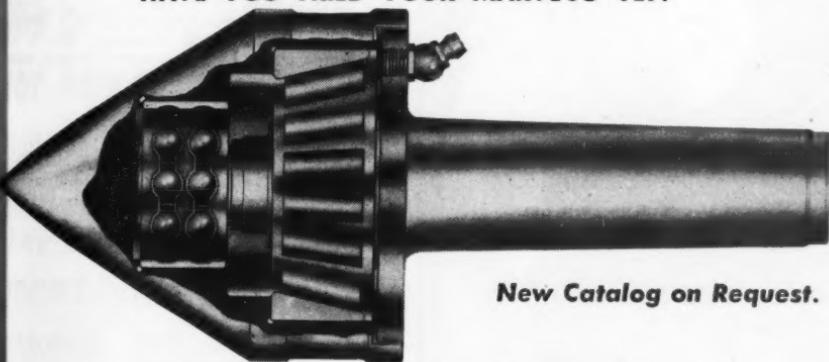
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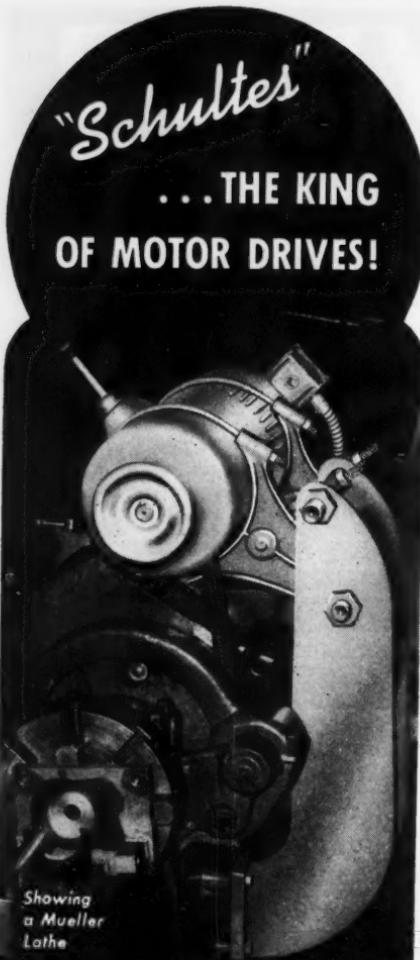
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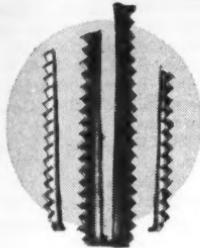
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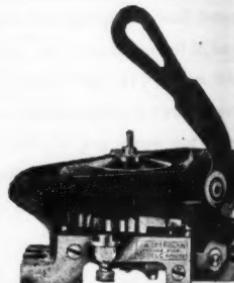
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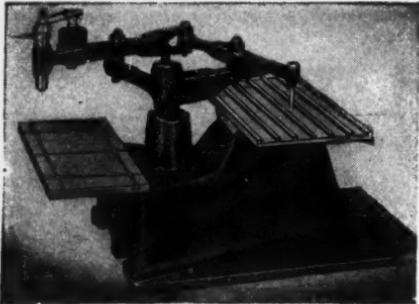
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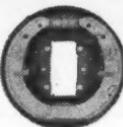


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Foot-controlled master-cylinder



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Simplifies the application of air power to hydraulic brake systems.



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Solve the Problem of
Handling a Maximum
of Bores with a Mini-
mum of Mandrels . . .



TYPE	Size No.	Range of Bores Taken	Net Price
A	1A	1/2" to 1"	\$12.00
STEP	2A	1 1/2" to 2 1/2"	16.00
JAW	3A	1 1/2" to 2"	23.00
DESIGN	4A	2" to 3"	34.00
	5A	3" to 4"	40.00



TYPE A MANDRELS are recommended for a large range of bores with few mandrels. Only five mandrels, each with one set of three jaws, hold work with all bores from $\frac{1}{2}$ " to 4". No. 1A has jaws with three steps, larger sizes have jaws with two steps. Can be used in hexagonal broached holes as well as round.

Write for Bulletin 1043.

W. H. NICHOLSON & CO., 136 Oregon St., Wilkes-Barre, Pa.

TYPE B—STRAIGHT JAW DESIGN

Size No.	Range of Bores Taken	Net Price
1X	1/2" to 1 1/8"	\$10.00
2X	1 1/8" to 2 1/32"	11.00
3X	2 1/32" to 3 1/8"	12.00
00	3 1/8" to 4 1/8"	14.00
0	4 1/8" to 1 1/2"	16.00
1	1 1/2" to 1 1/4"	18.00
2	1 1/4" to 1 1/8"	21.00
3	1 1/8" to 2"	29.00
4	2" to 2 1/2"	40.00

Other Sizes Taking Up to 7" Bores

TYPE B MANDRELS have longer jaw gripping surface, and accommodate longer, heavier work. 14 sizes will accommodate all bores from $\frac{1}{2}$ " to 7". The smaller sizes require only one set of jaws, intermediate sizes two sets, and larger sizes three sets. Each set consists of four jaws. For square holes as well as round.

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30 YEARS EXPERIENCE

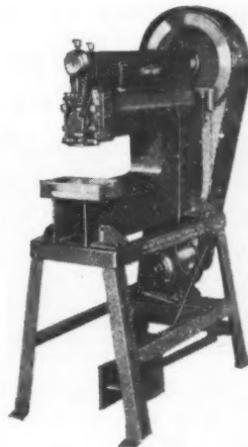
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**CAPACITY 10 TON
12" and 18" THROAT
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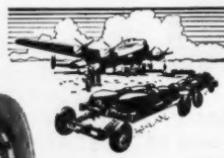
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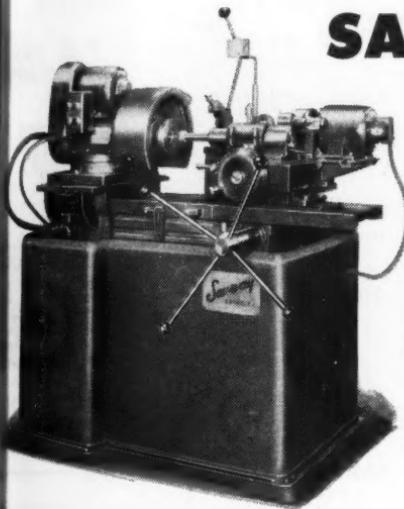
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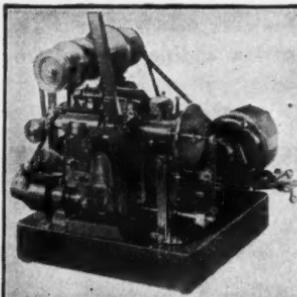
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BALANCING WAYS
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A sub base can be made of proper height to give necessary clearance for large diameter work.
Supersensitive ball bearings and hardened and ground spindles assure accuracy.

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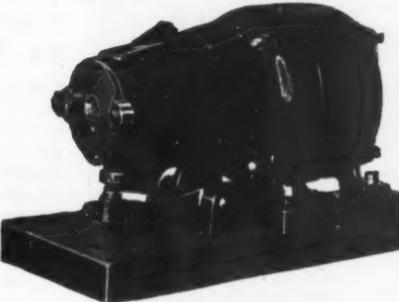
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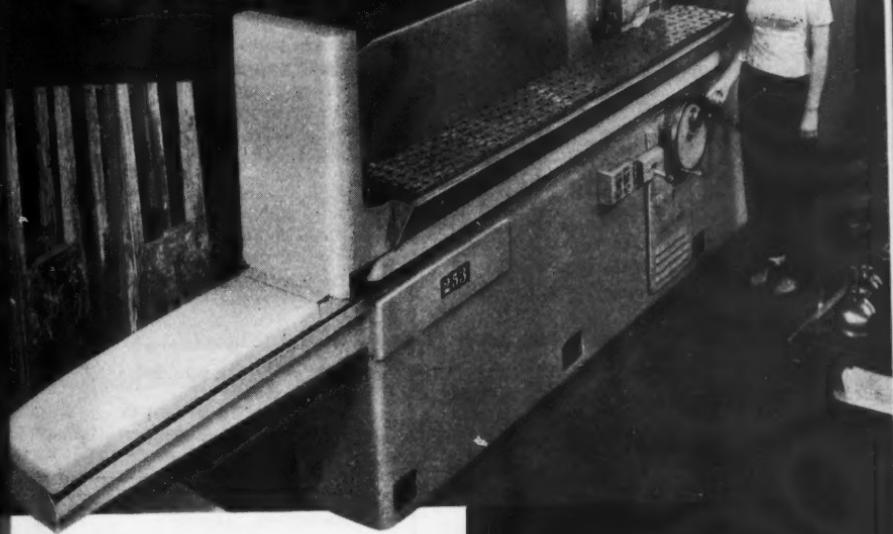
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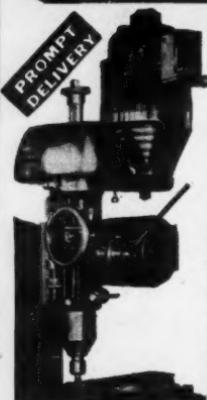


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ATTACHMENT for Heavy Duty Operations**



EASY MOUNTING

LARGE QUILL—
4" TRAVEL

(counter balanced,
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6 SPEEDS,
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Lever and Worm Feeds
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Specially engineered by RUSNOK to meet the demand for heavier duty end mill operations. Uses many types of cutters on a wide range of work. Large size spindle (No. 9 B & S taper). Takes $\frac{1}{8}$ " to $\frac{1}{4}$ " end mills. Precision Engineered and Ruggedly Constructed Throughout.

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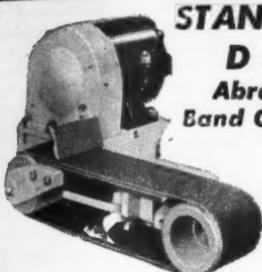
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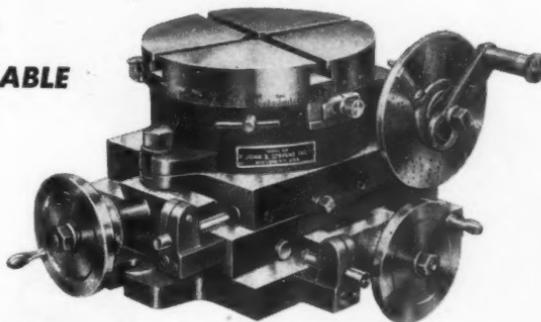
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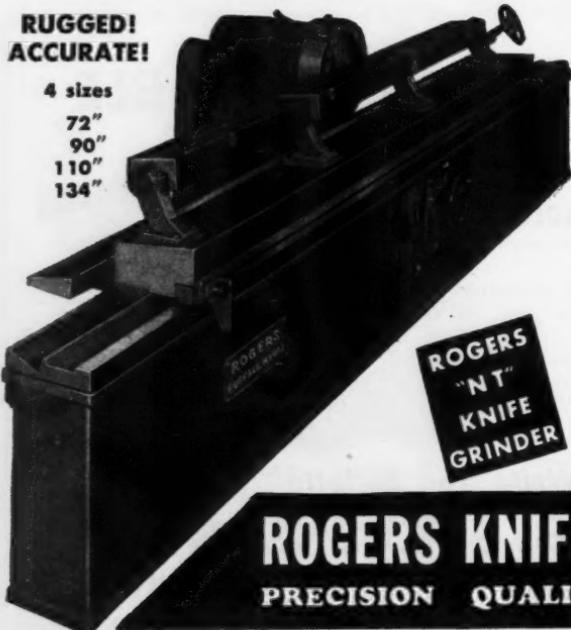
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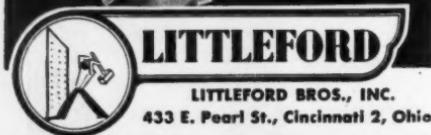
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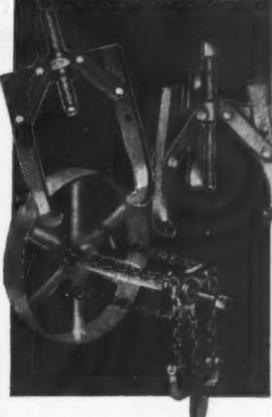
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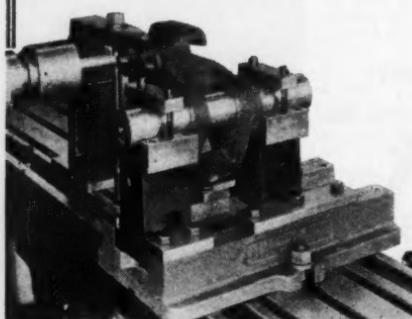
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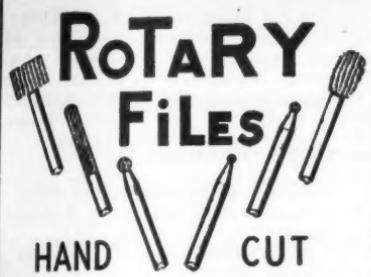
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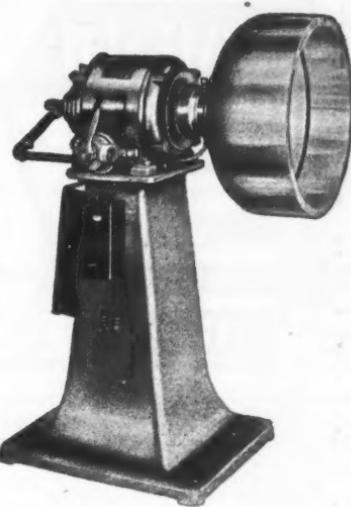


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October, 1944

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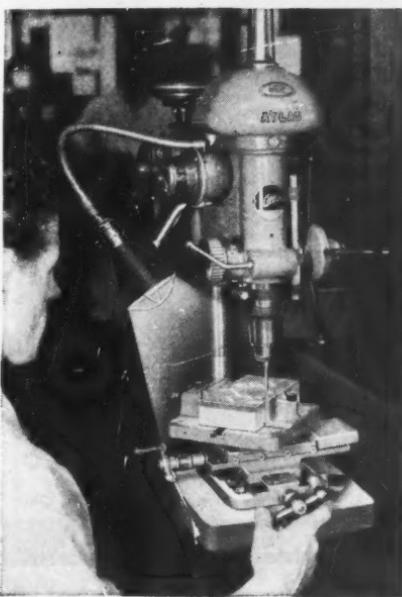
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Pittsburgh and Bellefonte, Pa.

Booth A-640

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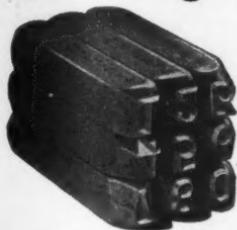
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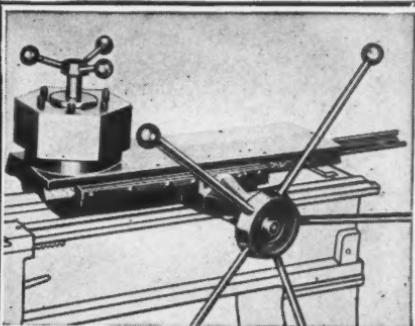
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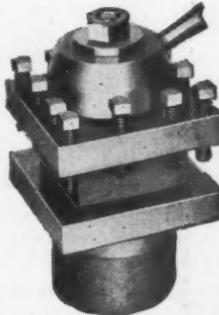
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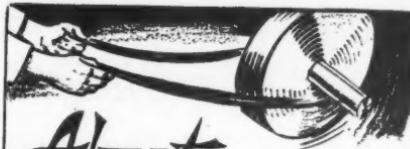
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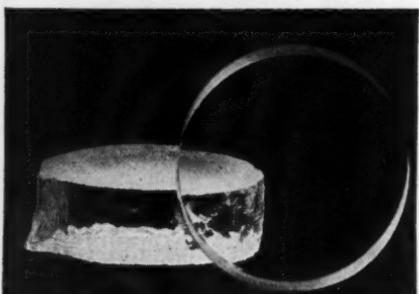
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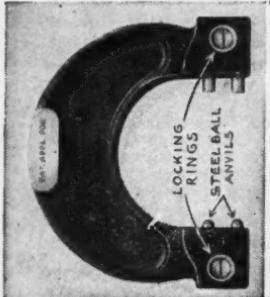
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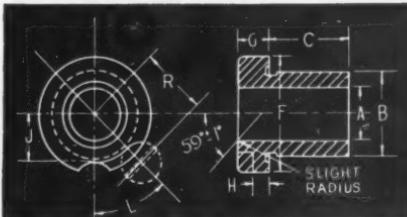
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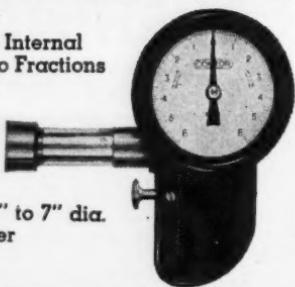
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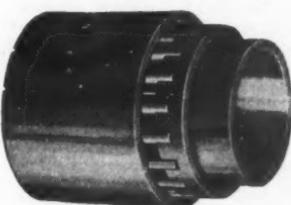
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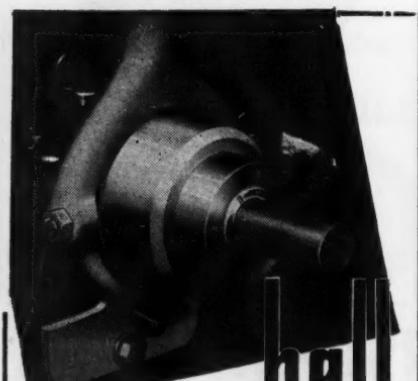
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Anglo-American News



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Immediate deliveries.

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October, 1944

LEACH External Grinder

PRICE
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Fully Equipped

Grinds Work
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Fast WORKER FOR ACCURATE TOOLING JOBS...



Despite the shifting around and changing of machine tools as industry reconverts, the LINLEY Milling and Jig Boring machine will still function as the "trouble shooter" in busy toolrooms. Dies, jigs, models, metal patterns and countless small jobs are handled easily, quickly and at low cost... saving larger machines for their rated duties.

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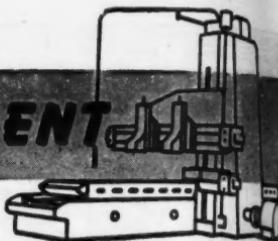
8 spindle speeds to 4250 r.p.m.; velvet feed, micrometer screw head; grease-sealed bearings; no backlash in quill

travel; ample table size and travel but small floor area (18½" x 20"); fast set-up; easy changeover... a precision machine that earns its keep from the start.

BULLETIN ON REQUEST

LINLEY BROS.
CO.
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NEW SHOP EQUIPMENT



Colonial Model CS2 Broach Sharpener

The illustration herewith shows the Model CS2 Broach Sharpener now being offered by the Colonial Broach Co., Box 37, Harper Station, Detroit 13, Mich. Especially designed for easy operation by women workers, the machine can be used in sharpening round and flat broaches—spline, serrated, and other types—up to 7 feet long and up to 6 inches in diameter and 8 inches in width respectively.

Of particular importance in making broach sharpening easy is the lightweight alloy construction of the sliding head which is supported on and guided by full anti-friction double-row roller bearings that are completely sealed against entry of grinding dust to ensure maintenance of ease of action of the head for the life of the machine.

Available on special order is an arrangement which makes possible the maintaining of identical steps per tooth in regrinding broaches. This arrangement comprises the use of Colonial dual-

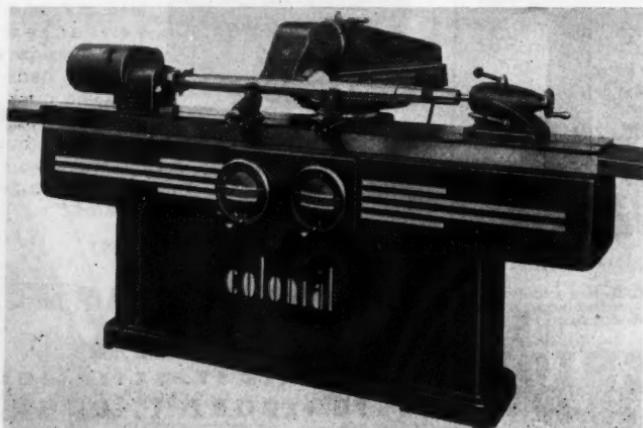
ratio micrometer handwheels with which feed can be controlled to ten thousandths of an inch.

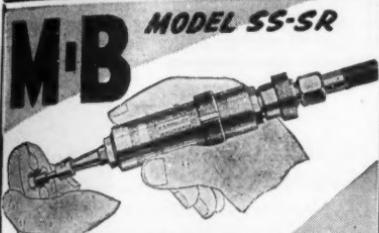
Also available on order is a special roller curtain design for protecting the ways of the machine when the table is moved to one side or the other. On the standard machine, metal guards are provided for this purpose. The roller curtain design permits a reduction of 10 feet in total floor space required when sharpening broaches of maximum length that can be handled on the machine.

Change-over from sharpening round to flat broaches can be accomplished quickly and conveniently without special tools and with few adjustments. Universal positioning and movement of the grinding wheel are obtained by means of a vertical column, a cross slide mounted on graduated support, and graduated wheel head mounting.

Headstocks for cylindrical broach sharpening are provided with reduced gearing affording spindle speed of 1000 r. p. m. Tailstocks are equipped with quick-release spring-loaded centers. Barrel type steady rests have contact points made from round fiber to prevent injury to broaches. Adjustable stops, cushioned by spring cushions, are provided for the broach head. A cross slide guard against shock at the end of the stroke of the head when sharpening flat broaches.

If desired, the Model CS2 can be obtained with a head and tailstock.





**"SUPER-SPEED" Pneumatic
GRINDER**

A 100,000 R.P.M. UNIT

A powerful, fast-cutting tool, streamlined in design, easy to handle. Designed for real production work and the toughest jobs. Precision made, excellent balance. Special grease-sealed bearings . . . no lubrication required. Fitted with steel housing, a special safety feature. WRITE FOR CIRCULAR.

M-B PRODUCTS

130-134 E. LARNED ST.
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ARMSTRONG-BRAY
STEELGRIP
STANDARD BELT LACING



**STEELGRIP
BELT LACING**

A strong lacing for all types of belts. Put on with a hammer in a few minutes. Clinches smoothly into belt, compresses ends, prevents fraying. 2-piece hinged rocker pins provided. 11 sizes. In boxes, handy packages, cartons and long lengths. Write for catalog sheets.

ARMSTRONG-BRAY & CO.
"The Belt Lacing People"
5346 Northwest Highway, Chicago 30, U.S.A.

BELT LACING
Both types from
1 source

BELT HOOKS come with blue aligning cards that prevent waste—every hook can be used. Protects fingers. Applied with a WIREGRID or any other standard Belt Lacing Machine. 6 sizes.

**ARMSTRONG-BRAY
WIREGRID**
BELT HOOKS



**INCREASE YOUR
METAL CUTTING
PRODUCTION**

In selecting hack saws that are needed today on production lines, you will always get results with GRIFFIN. The line is complete . . . a blade for every cutting job . . . the quality proven by 63 years of experience.

Distributors have them.

JOHN H. GRAHAM & CO., INC.

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105 DUANE ST.

NEW YORK CITY

Made by G. W. GRIFFIN CO., Franklin, N. H.

GRIFFIN

Hack Saw Blades

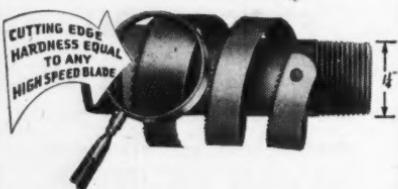
SAFETY

WITH

Hackmaster

Reg. U. S. Pat. Off.

UNBREAKABLE HAND BLADE



Molybdenum High Speed Steel

SAFETY. Hazards and accidents of sawing are eliminated by the use of these Safety Hand Blades. Inasmuch as these are unbreakable blades they will withstand hard usage, even misuse, without shattering. Sharp twists and kinks, which are the main reason for saw breakage, are absorbed without damaging these blades.

"LENOX"

American Saw & Mfg. Co.
Springfield, Mass.

stocks, steady rests, and so on, for sharpening flat broaches only. Magnetic chucks for grinding flat broaches are available as extra equipment.

Michigan "860" Series Rotary Crossed-Axis Gear Finishing Machines

Designated as the "860" Series, an improved line of rotary crossed-axis gear finishing machines is now in production at the Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich. The line comprises four basic models—the 860 for shaving narrow face and shoulder gears by the "underpass" method; the 860-B for shaving wide face gears by the "transverse" method; the 860-A in which both the "underpass" and "transverse" shaving methods are provided; and the 860-C for shaving of internal gears. The first three models are available in three sizes for shaving gears with maximum O. D. of 8, 12, and 16 inches.

All 860 Series machines utilize Cone-Drive gearing which is said to ensure maintenance of initial operating clearance tolerances over long periods. In addition, with the greater rigidity provided in the machines, motor power has been increased to 2 h. p. to afford a reserve for special jobs. Improved facilities for curve shaving are available as optional equipment on the 860 machines.

Great ease of adjusting reciprocating speeds is afforded on all improved machines. On the 860, 860-B, and 860-C, two sets of change gears are provided, one set affording five variations in cutter spindle speed while the other provides five variations in speed of the reciprocating mechanism. On the 860-A

New Nesting Type Tote Pan



20" long x 12" wide x 6 1/2" deep.
16 ga., drag holes and handles both ends.

J. L. LUCAS & SON, INC.
Bridgeport, Conn.

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Magnetics are



M-D Facing Heads

With Automatic Feed

Can be attached to Boring Mill Bar, and Drilling or Milling Machine spindles. Single point tool travels radially, from center outward or reverse, feeds automatically. Sizes 6" to 46" diameter.

Write for circular.

MUMMERT-DIXON CO.
120 PHILADELPHIA ST. HANOVER, PA.



DRILL THESE HOLES

BY A QUICK, EASY, INEXPENSIVE METHOD

Your business letterhead will bring literature.

WATTS BROS. TOOL WORKS

Wilmerding, Pa.



EXPANDING MANDRELS

Any size hole within a 1" range of infinite variation! That's what one size Champion Expanding Mandrel will completely and accurately handle. The hardened steel flexible sleeve automatically expands to the correct size as it is raised on the tapered arbor. Only 12 champions needed for range from $\frac{1}{2}$ " to $6\frac{1}{2}$ ". Eliminates numerous solid mandrel sizes. More convenient. Costs $\frac{1}{3}$ less. Proved for years by thousands of shops.

The WESTERN Tool
and Manufacturing Co.
SPRINGFIELD, OHIO

SEALED PROTECTION FOR FINE TAPS

Reiff & Nestor Taps now delivered to you sealed in a Moisture Proof, Shock-Resistant, Tough, Plastic jacket that gives the cutting edges the perfect protection fine tools deserve.

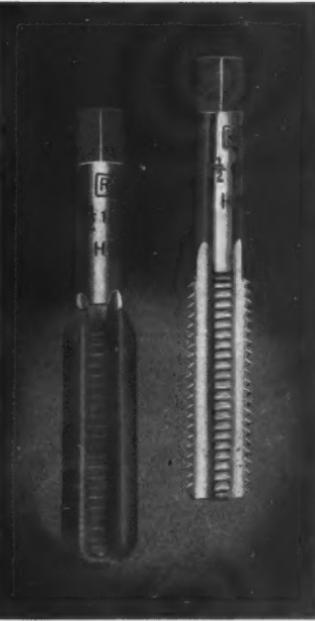
No more chipping in transit or injury from Tool Room handling.

Reiff & Nestor Plastic jacket is easily removed and may be used again and again.

There is no extra charge for this Reiff & Nestor innovation.

The new Reiff & Nestor Catalogue and Tapping Guide — Just out. A request on your Letter Head brings it.

REIFF & NESTOR CO.
LYKENS, PENNA.



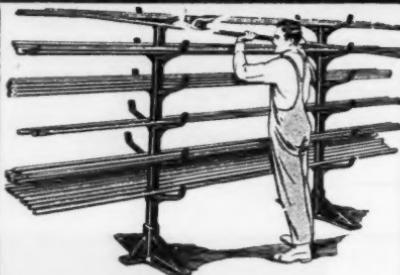
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on which two optional methods of shaving gears (underpass or transverse) are offered, separate provisions are made for change gears for each of the movements. The design is such, however, that the same actual gears can be used interchangeably for the underpass or transverse change gears. Standard machine equipment includes six gears each for cutter spindle and reciprocation speed changes.

In line with mechanical improvements providing longer service life of the 860 Series machines, these models feature more efficient sealing to further reduce

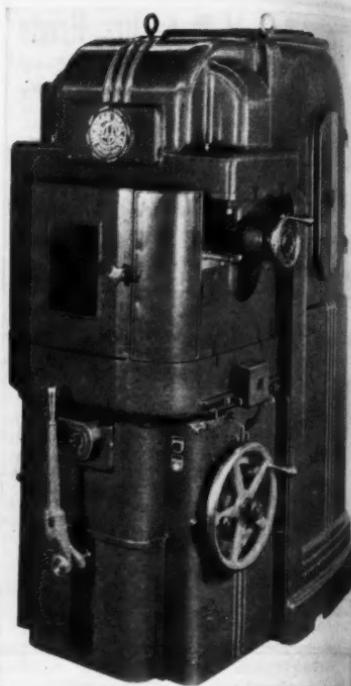
SAVES TIME IN YOUR STOCK ROOM



The BROWN SECTIONAL RACK saves the time wasted end-hauling stock from the old-style, closed-side rack and quickens the selection of sizes by greater visibility. Built of standard metal sections: can be expanded for changes in stock or growth of business. Made in 5 styles: can't burn, depreciation practically nil.

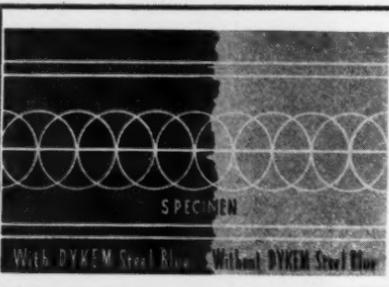
SEND FOR BULLETIN 26-M.

BROWN
ENGINEERING CO. 120 N. THIRD ST.
READING, PA.



Michigan 860-A Rotary Crossed-Axis Gear Finishing Machine

maintenance requirements. A "one shot" lubricating system is provided for oiling all moving parts. Control panels are enclosed for protection against dirt and dust, leaving only the simple cycle controls exposed for accessibility in machine change-overs. Outer housings are also provided with improved seals to protect against en-



DYKEM STEEL BLUE

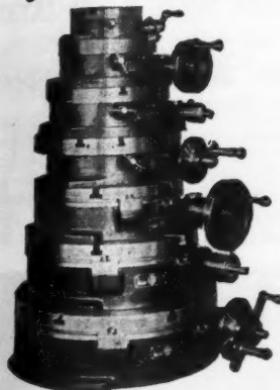
Stops Losses in Making Dies and Templates

Simply brush on, right at the bench; ready for the layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, and at the same time prevents metal glare. Increases efficiency and accuracy.

Write for full information.

THE DYKEM COMPANY
2301 F. NORTH 11th ST. ST. LOUIS, MO.
(In Canada: 444 Pacific Av., Toronto, Ont.)

Troyke Rotary Tables



Sizes 9", 12", 15", 18"

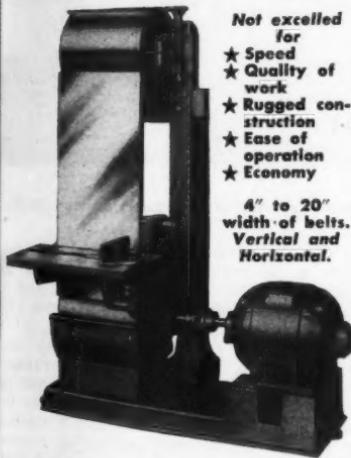
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eight page catalog.

ALFRED A. TROYKE

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PEERLESS ABRASIVE SURFACER



Not exceeded
for

- ★ Speed
- ★ Quality of work
- ★ Rugged construction
- ★ Ease of operation
- ★ Economy

4" to 20"
width of belts.
Vertical and
Horizontal.

Production Machine Co.
GREENFIELD
MASS.

A "one
provid-
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U.S., NO.
October, 1944

HAVE AN ACE UP YOUR SLEEVE FOR POST-WAR

How about that post-war product you have been rolling around in your mind? Let Ace help you plan its construction and production. Ace has a complete service offering many real advantages to anyone considering products that involve small parts and assemblies requiring stamping, machining, heat-treating, or grinding.

Here under one roof are the ingenuity and modern equipment to help you design that product of yours . . . make the necessary tools and dies . . . and put it into production. Furthermore, on certain products, we have a complete sales and merchandising staff to put it on the market.

Have an Ace up your sleeve. Plan with Ace now.



ACE MANUFACTURING CORPORATION
for Precision Parts



1235 E. ERIE AVE., PHILADELPHIA 24, PA.

MODERN MACHINE SHOP 315

TAPPING TIPS

From Woody Spencer's Notebook

For Copper, Skim Milk!



Skim Milk—for tapping Copper! Sounds screwy? Well, it sounded that way to me too when I first heard about it. And when I suggested it to some of the boys, all I got was a "Bronx Cheer." But I saw it work, and I never saw a smoother job... no tear, no crumble. Since then I've known a lot of copper jobs that went mighty smooth with "barnyard" lubricant. Next time you have a copper tapping job, try it.



"Tapping Tips" are no cure-all for all tapping problems. They are just intended to be helpful, perhaps to save a little time or smooth out some of the run-of-the-mine tapping jobs.

For a real tapping problem, we urge, "get a specific engineering recommendation." Send us complete details of your operation (material, diameter, depths and all the facts we should know). Our engineers will then be glad to make definite suggestions to cover your problem.

***Note:** Woody Spencer's Tapping Tips will appear here as regularly as "Woody" gets time to write them up. Watch for them.

THE RIGHT TAP AT THE RIGHT TIME!

The Wood & Spencer Company
Cleveland 3, Ohio



of foreign matter. Vernier scales on the front of these housings simplify crossed axis settings.

DoAll "Zephyr" High Speed Sawing Machine

Especially designed to meet versatile sawing requirements, a high speed sawing machine to be known as the DoAll "Zephyr" is now being manufactured by Continental Machines, Inc., 1306 Washington Ave., Minneapolis 4, Minn.



DoAll "Zephyr" High Speed Sawing Machine

Rigidly constructed, the machine features a 36-inch throat depth and 1½ inch work thickness capacity and is provided with speed range of from 1500 to 10,000 feet per minute.

The speed range is infinitely controlled by a "Speedmaster" variable speed pulley. A "job selector" dial indicates the saw control factors for the shaping of 104 basic materials, including plastics, plywood, asbestos, rubber, metal sheet stock, nonferrous alloy castings, cast iron and alloy steels.

To protect the operator at the point of work, automotive hydraulic brakes are provided on the upper and lower

GRAY TURRET HEAD
METAL CUTTER OR NIBBLER



GRAY, Originator of
First Practical Metal
Cutter or Nibbler

Most modern Nibblers for
Template Cutting, Tool
Rooms, Shipbuilding, Air-
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GEARS GOOD GEARS ONLY

All Kinds—Any Quantity

AT THE RIGHT PRICE

THE CINCINNATI GEAR CO.
Wooster Pike
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VARIOUS WIDTHS
and GAUGES



BUTTS AND ■
CONTINUOUS LENGTHS

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S & S MACHINE WORKS

4533 W. LAKE STREET HARDWARE DIVISION CHICAGO, ILLINOIS

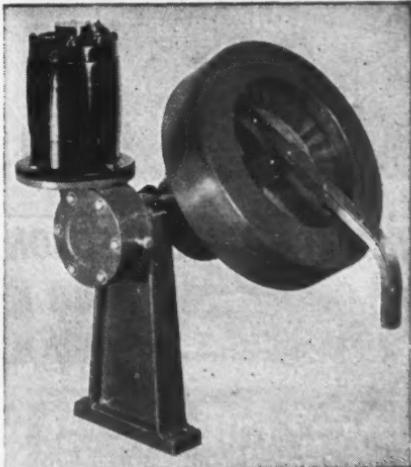
MOTORIZED HOPPER UNITS

ADAPTABLE TO ANY
MACHINE.

FEED BULLET CORES,
SCREWS, PINS, WASHERS,
BEARING ROLLERS, NUTS,
RIVETS, SPECIAL PARTS.

Send Samples for
Information and Prices.

DETROIT POWER
SCREWDRIVER CO.
2807 West Fort St.
DETROIT 16 • MICHIGAN



controls and the foot pedal controlling the hydraulic brakes are located within easy reach of the operator.

Standard equipment of the DoAll Zephyr includes a 10 h. p. variable speed drive and a 30 x 30-inch work table with a secondary table extension of 17 x 20 inches. The machine has a four-way table tilt—45 deg. to the right, 10 deg. to the left, front and rear—and an adjustable table lamp for illumination at the point of work. Pipe flange arrangements are provided for exhaust removal of chips.

The upper wheel of the machine is spring tension mounted so that the band is under proper tension at all speeds. The special saw guides provided are adjustable for saw bands from $\frac{1}{4}$ to $1\frac{1}{2}$ inches wide. The machine is supplied complete with an assortment of saw bands.

U. S. No. T-124 Angle Correcting Radius Dresser

Designed not only to do the work of radius dresser but also to dress the corrected radius on a wheel for grinding compound and compound-complex angles on flat form tools, and so on, the U. S. No. T-124 Angle Correcting Radius Dresser shown herewith has been placed on the market by the U. S. Tool & Mfg. Co., 6906 Kingsley, Dearborn, Michigan. To eliminate guesswork in dressing wheels, the unit employs the direct reading principle.

To use, the diamond dresser mechanism is swung through specific number of degrees, as indicated by graduated scale located at right angle.

★ ★ THE HILLIARD ★ ★

SINGLE REVOLUTION Clutch

Never extremely accurate control of intermittent machine operation is essential the Hilliard Single Revolution Clutch is unequalled. Its accuracy has won for it the acceptance of industry for cutting, punching and packaging operations.

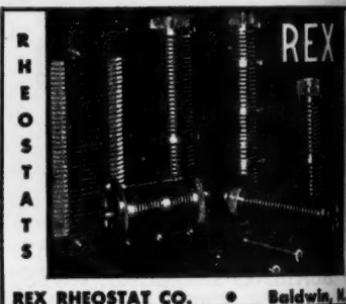
★ WRITE TODAY! ★

For information that will help you to adapt the Clutch to your needs.

THE HILLIARD Corporation

117 WEST 4TH ST ELMIRA, N.Y.

★ OVER RUNNING SLIP CENTRIFUGAL FRICTION ★



REX RHEOSTAT CO. • Baldwin, N.Y.

ILLUMINATED INSPECTION BORESCOPE

LENOX Instruments explore the dark holes of industry—guns, turbine rotors, hollow shafts, tubes, tanks, well drill pipe, cartridge cases, etc.

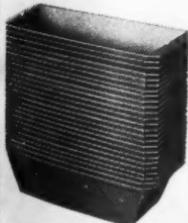
LENOX INSTRUMENT COMPANY

U.S.A. Pioneers. Twenty years. Let us solve your problem. Give diameter and length of cavity to be inspected.

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PREWAR QUALITY!

**QUICK DELIVERY ON
STEEL SHOP BOXES!**



A-S-E Taper Pans—
Saves Storage Space

**TAPER
PANS**
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**STACK
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**STACKING
BOXES**

All-Steel-Equip Company

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SPECIFY

GITS
Oilers

for **POSITIVE,**
DEPENDABLE
LUBRICATION
under all conditions

Over 30 years of specialized research, designing and manufacturing of every conceivable type of lubricator, is your guarantee of a scientific answer to all of your lubricating problems. Gravity Feed, Wick Feed, Constant Level and Multiple (manual and automatic) Oilers, Oil and Grease Seals are fully described in Catalog No. 60—write for your copy.

GITS BROS. MFG. CO.

945 South Kilbourn Avenue • Chicago 23, Illinois

Exclusive for over 35 years

BROKEN TAPS

Out in a Jiffy!

The Walton Tap Extractor beats out makeshift methods—saves time and money. It's insurance against trouble.

With a range of sizes to meet your needs you'll no longer be faced with production slowups caused by broken taps.



We'll show you how, and tell you about our reconditioning service for worn and damaged extractors.

Write for Folder No. 10.

LIST PRICES

From \$1.50 to \$5.00 each

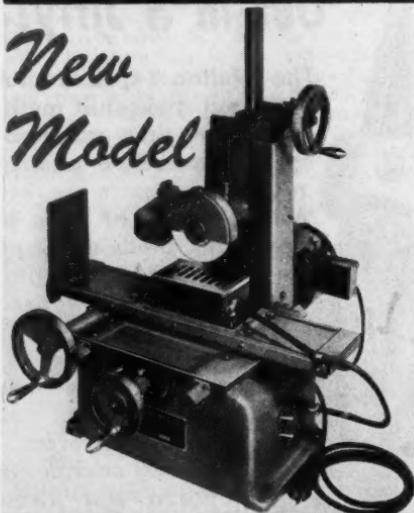
**IMMEDIATE
DELIVERY**



The WALTON Company
94 ALLYN STREET • HARTFORD, CONN.

SANFORD

New
Model



BENCH SURFACE GRINDER

ACCURACY WITHIN .0001

New Features

- ★ Longer Stroke
- ★ Mechanite Castings
- ★ Sturdier Construction
- ★ Adjustments for Alignment
- ★ Improved Drive

Prompt Delivery

Write for Bulletin

Available on M.R.O. Certifications

SANFORD MFG. CO.
1279-81 SPRINGFIELD AVE.
IRVINGTON 11, NEW JERSEY

to the dressing axis, and locked in position. The dresser is then placed on chuck exactly on the center line of the grinding wheel, which is subsequently dressed to the radius required. For compound-complex angle, the same procedure is followed with the addition of swinging the base of the dresser away from the parallel bar of the chuck using the upper righthand corner of the base of the dresser as the pivot point and directly reading the angle (from blueprint) as before.

Equipped with Timken tapered roller bearings, the U. S. No. T-124 Angle



U. S. No. T-124 Angle Correcting Radius Dresser

Correcting Radius Dresser is light weight yet sturdy in construction to insure the production of smooth and precise radii. Both angle scales are easy to read and easily accessible. All exposed unpainted parts of the unit are chrome finished to guard against stain and rust. In addition, the dresser is constructed with a hardened tool steel wear plate on the underside of the base to prevent chipping and wearing of the cast iron body.

Tombill Drill Sharpener

An attachment for use in sharpening twist drills from No. 70 to 15/64 in. to be known as the Tombill Drill Sharpener, is now being manufactured by Mercury Products Co., 423 Euclid Ave., Cleveland, Ohio. Designed for use on any standard 6-inch or smaller grinding wheel, the attachment includes an illuminated magnifier and alignment bar for positioning drill for sharpening.

To use, the alignment bar is pushed under the drill inserted in chuck, and chuck tightened. Next, the operator looks through magnifying glass and lines up tip of drill on the alignment bar. Grind

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October, 1944

Diamond B-12 BENCH MILL

IT'S STURDY! 435 lbs. of carefully designed, accurately machined castings.

IT'S ENGINEERED! Timken tapered roller bearings on the spindle. Needle bearings in the overarm bracket. Spindle heat treated, nose hardened and ground. Screws protected from chips. Many modern features.

IT'S FLEXIBLE! A wide range of spindle speeds (from 100 to 1400 r.p.m.) for small end mill operations or heavy cuts with large diameter milling cutters. Accessories include vertical milling head, power longitudinal screw feed, rack and pinion feed, coolant supply, etc.

IT'S POWERFUL! Double vee belts put plenty of power on the spindle—speeds are quickly altered by flipping the belts on pulleys. Rapid belt adjustment keeps belts tight or instantly releases tension for belt changes. Recommended motor size $\frac{1}{2}$ to $1\frac{1}{2}$ h.p.

IT'S ECONOMICAL! Model B-12 Diamond Bench Mill is sold on M.R.O. for only \$350.00 F.O.B. Los Angeles. Write for specifications and information!

DEALERS WANTED FOR MORE INFORMATION WRITE
DIAMOND TOOL COMPANY
3427 E. OLYMPIC BLVD., LOS ANGELES 23, CALIFORNIA

**AMERICA'S BIGGEST
BENCH MILL
for only \$350.00**



MODEL B-12
DIAMOND
BENCH MILL

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DIAMOND
TOOL CO
L.A.

Manufacturers of the DIAMOND Line of Precision Milling Machines and Accessories

C-F POSITIONERS

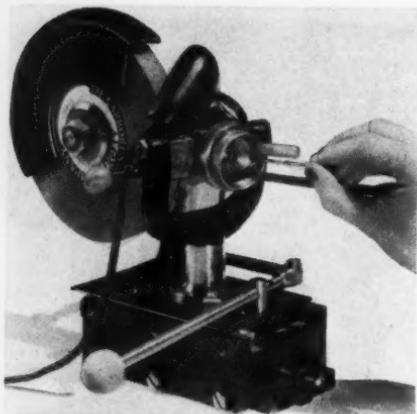
Handle the BIG JOBS Easily and Safely

With C-F Positioners each welder can position even the most cumbersome weldments with a push button control—without crane work or handling crews. He can rotate the weldment a full 360° , rotate it at any speed from 0 R.P.M. up and can tilt it to 135° beyond horizontal... can weld all sides, surfaces and angles down-hand with a single set-up: with larger rods and fewer passes. All C-F Positioners, both stationary and portable, are pedestal mounted to give maximum floor and working clearance; all are adjustable for height.

Write for Bulletin WP-22

CULLEN-FRIESTEDT CO.
1511 S. Kilbourn Ave.
Chicago 23, Ill.





Tombill Drill Sharpener

bar is then slowly depressed to limit and released, one lip of the drill being finish ground. To grind the other lip, the chuck is revolved 180 deg. and the grinding bar again depressed slowly and released. Every size drill to be ground on the attachment requires a separate bushing, ten of which are supplied.

EutecRod 195

Zinc base die castings, normally difficult to repair, are said to be easily and effectively reclaimed through the use of the improved gas welding rod—Eutec-Rod 195—now being marketed by Eutec-Crystal Welding Alloys Co., 40 Worth St., New York 13, New York.

According to the manufacturer, the improved rod has a lower melting point and lower bonding temperature than the original alloy, thus making it easier to apply without danger of damaging the parent metal. In addition, the rod is said to be easier to build up with, and have greater tensile strength.

Beg Your Pardon!

In the announcement of the DoAll Economy Gage Block Set, which was published on page 264 of the July issue of this magazine, the wrong illustration was used. The DoAll Economy Gage Block Set actually includes 37 gage blocks as shown in the illustration.

Included in the 37 blocks are two 0.050-inch wear blocks in addition to five standard series of gage blocks. The first series consists of nine blocks from 0.1001 to and including 0.1009 inch in increments of 0.0001 inch. The second series consists of nine blocks to and including 0.109 inch in increments of 0.001 inch. The third series consists of nine blocks from 0.110 to and including 0.190 in increments of 0.010 inch. The fourth series consists of five blocks



DoAll Economy Gage Block Set

from 0.100 to and including 0.500 inch in increments of 0.100 inch, and the fifth series consists of three blocks 1.0, 2.0 and 4.0 inches. With these several series any measurement from 0.050 to 11.7995 inches can be made in increments of 0.0001 inch.

DON'T DISCARD DULL TAPS!



**NEW
READING
TAP
GRINDER**

Prompt delivery!

READING TAP GRINDER can be used on tool and cutter grinders—surface grinders—even bench lathes. Taps sharpened after center is destroyed. **No collets.** Complete. No extras. Write.

Broach Keyseater

The Reading Bench Machine does not require bushings or guides. Very fast capacity from $\frac{1}{8}$ to $\frac{7}{8}$ cutter. Low first cost.

READING MACHINE COMPANY
READING (CINCINNATI), OHIO

